Genetic and Environmental Influences on self-reported G-Spots in Women: A Twin Study

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ABSTRACT

Introduction. There is an ongoing debate around the existence of the G-spot—an allegedly highly sensitive area on the anterior wall of the human vagina. The existence of the G-spot seems to be widely accepted among women, despite the failure of numerous behavioral, anatomical, and biochemical studies to prove its existence. Heritability has been demonstrated in all other genuine anatomical traits studied so far.

Aim. To investigate whether the self-reported G-spot has an underlying genetic basis.

Methods. 1804 unselected female twins aged 22–83 completed a questionnaire that included questions about female sexuality and asked about the presence or absence of a G-spot. The relative contribution of genetic and environmental factors to variation in the reported existence of a G-spot was assessed using a variance components model fitting approach.

Main Outcome Measures. Genetic variance component analysis of self-reported G-spot.

Results. We found 56% of women reported having a G-spot. The prevalence decreased with age. Variance component analyses revealed that variation in G-spot reported frequency is almost entirely a result of individual experiences and random measurement error (>89%) with no detectable genetic influence. Correlations with associated general sexual behavior, relationship satisfaction, and attitudes toward sexuality suggest that the self-reported G-spot is to be a secondary pseudo-phenomenon.

Conclusions. To our knowledge, this is the largest study investigating the prevalence of the G-spot and the first one to explore an underlying genetic basis. A possible explanation for the lack of heritability may be that women differ in their ability to detect their own (true) G-spots. However, we postulate that the reason for the lack of genetic variation—in contrast to other anatomical and physiological traits studied—is that there is no physiological or physical basis for the G-spot. **Burri AV, Cherkas L, and Spector TD. Genetic and environmental influences on self-reported G-spots in women: A twin study. J Sex Med **;**:**–**.**

Key Words. G-Spot; Twin Study; Genetics; Heritability

Introduction

Knowledge of the anatomy, biology, physiology, and pathophysiology of female sexual function is limited. Female orgasm, in particular, is a complex phenomenon that is far from being understood. Findings from population-based studies and clinical reports suggest that orgasm concerns are the second most frequently reported female sexual problem [1]. Female orgasm is described as a "variable, transient peak sensation of intense pleasure that creates an altered state of consciousness" and can be induced through a variety of ways such as oral or manual stimulation of the external clitoris, stimulation of the vaginal wall structures through penetration, and stimulation of nongenital sites [2,3]. Further studies have indicated the importance of psychosocial variables such as age, education, social class, erotic perceptions, relationship issues, hormonal, neural, and vascular factors on the ability to orgasm. We recently published on the importance of emotional intelligence and personality on orgasm, based on the same cohort as the current study [4–6]. Despite these studies, no clear explanation for what triggers orgasm has emerged [1,2].

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Recent research in this field has predominantly focused on the physiological role of anatomical factors in the huge variability observed in female sexual response. In two very recent introital ultrasonography studies (n = 37; n = 20), Gravina et al. found a significant correlation between the variability in thickness of the urethrovaginal space and the ability of women to experience orgasm through vaginal penetration [7,8]. Another functional sonography study on a very small sample (n = 5) suggested that the apparent sensitivity of the lower anterior vaginal wall could be explained by pressure and movement of the root of the clitoris during vaginal penetration and subsequent perineal contraction [9].

The idea of the G-spot was first proposed as long ago as 1950 by Dr. Ernst Graefenberg. He described the existence of an allegedly highly sensitive area on the anterior wall of the human vagina, halfway between the pubic bone and the cervix, along the course of the urethra [10]. The term "G-spot" was later coined by Beverly Whipple and John Perry in reference to Dr. Grafenberg's discovery [11]. They observed in small behavioral studies that stimulation of this particular area resulted in high levels of sexual arousal and powerful orgasms [12,13].

Other studies claimed that stimulation of the G-spot—during autoerotic masturbation but mostly during coitus in the obverse position—provokes a nonurine fluid emission, the so-called female ejaculation. A review of the literature lead Sevely and Bennett to conclude that the source of female ejaculation were the Skene glands, a female equivalent to the prostate glands, which have ever since, been associated with the phenomenon of female ejaculation [14]. Several years later, Crooks and Baur confused the concept by stating that the G-spot itself consisted of a system of glands and ducts [15].

There is still an ongoing heated debate around the existence of the G-spot as a biological phenomenon [16,17]. Following publication of the popular book on human sexuality "The G-spot and other recent discoveries about human sexuality," the existence of a G-spot has been widely accepted among women, the nonscientific population, and the press [18]. Numerous behavioral, anatomical, and biochemical studies have tried to prove the existence of the G-spot by examining vaginal erotic sensitivity and claiming that orgasmic response could be elicited by stimulating specific zones felt through the anterior wall of the vagina [19–22]. However, most of the studies are inconclusive as they rely on very small sample sizes. As a result of high variability in their findings and lack of replication, the presence of the G-spot as a specific area felt through the anterior wall that triggers orgasm has never been conclusively proven.

Research clearly shows a wide physiological variability in orgasm in women. Whether differences in women's sexual function and response is because of local anatomical dissimilarities such as the presence or absence of the "G-spot" or can be attributed to lifestyle factors like sexual technique, experience, or partner performance, remains to be answered.

The aim of this study is to quantify the contribution of genetic, as well as shared and unshared environmental factors to the variance of the frequency of a self-reported G-spot in female twins. We have previously shown the clear heritable nature of orgasm itself, by both intercourse and masturbation [23]. If the G-spot is in fact a physiological or anatomical phenomenon, then we would also expect an identifiable heritability.

Methods

Subjects and Questionnaire

Subjects were monozygotic (MZ) and dizygotic (DZ) female twins enlisted in the TwinsUK registry [24]. All twins in the registry were recruited through national media campaigns and from other twin registers. The twins have undergone extensive clinical investigations and have been shown to be comparable with age-matched singletons in terms of disease and prevalence of lifestyle characteristics [25–27]. The study was approved by the St. Thomas' Hospital research ethics committee and all twins provided informed consent. Zygosity was established by using standardized questions about physical similarity that have over 95% accuracy when judged against genotyping [28,29]. Zygosity was further confirmed by multiplex DNA genotyping in cases of uncertainty.

A postal self-administered questionnaire assessing sexual behavior, health, lifestyle, personality, and demographic information was sent to 4,625 unselected female twin individuals in the registry (Table 1). The questionnaire included the validated *Trait Emotional Intelligence Questionnaire-Short Form* (TEIQue-SF). This 30-item questionnaire was designed to efficiently measure global trait emotional intelligence and is based on the long form of the TEIQue, which has been used in numerous studies to assess the emotional aspects of personality [5,30]. Personality was also assessed using the Ten-Item Personality Index (TIPI) that consists of validated questions summarizing five personality types: extroversion, agreeableness, conscientiousness, emotional stability, and openness to experiences [6]. Participants were not aware of the hypotheses being tested in this study.

Classification

Existence of a G-spot was classified as a dichotomous trait on the basis of a subject's response to the question: "Do you believe you have a so called *G-spot*, a small area the size of a 20p coin on the front wall of your vagina that is sensitive to deep pressure?" We did not use the terminology "Graefenberg Spot" as this might be confusing to some respondents. Two items pertaining to frequency of experiencing orgasm during intercourse and masturbation were included in the questionnaires, using a 7-point Likert response scale from "never" (1) to "always" (7) (see Table 2). The 30 items of the TEIQue-SF and the 10 items of the TIPI were each summed (according to scoring protocol) and treated as continuous variables. Response scales of all other items used in the analyses of this study are shown in Table 2.

Statistical Analysis

Multivariate logistic regression was used to determine the relationship between G-spot reporting (dichotomous variable) and the different dichotomous, ordinal, and continuous independent variables. All tests were two-tailed. Potential confounders including age, education level, social class, emotional intelligence, personality, and sex during the past 3 months and number of sexual partners were also tested using logistic regression (Table 3). Age was found to have a substantial influence on whether a G-spot was reported ($P < 0.001$), with older women less frequently reporting the existence of a G-spot compared with younger women. Age was therefore included in all subsequent analyses as a confounder. We also conducted a stratified analysis to test whether identical regression models were appropriate for women aged under or over 55. We tested the regression models separately within each age group as well as in the total sample (Table 2).

Nonindependence of twin pairs was accounted for by using the cluster function for familial relatedness, which is a form of conditional regression. A two-sample test of proportions was performed to look for differences in (i) orgasmic preferences (clitoral vs. penetration) and (ii)

Table 1 Sample characteristics studied by zygosity and as an overall sample

	Overall (n = 1,804)	DZ (n = 924)	MZ (n = 880)	*P* value
Mean age (years)	55.2 (23–83)	55.9 (26–82)	54.4 (23–83)	0.004
Marital status				
Single	6%	6%	5%	0.35
Married	67%	66%	69%	0.17
In relationship, living with partner	8%	8%	6%	0.09
Divorced	8%	6%	8%	0.09
Widowed	5%	8%	5%	0.01
In relationship, not living with partner	6%	6%	7%	0.39
Education—in years (M, SD, range)	10.4, 2.8, 6–28	10.3, 2.7, 7–28	10.6, 2.9, 6–28	0.01
Number of partners (M, SD, range)	5.2, 6.5, 1–99	5.1, 6.8, 1–99	5.3, 6.2, 1–45	0.58
Emotional intelligence (M, SD, range)	153.4, 25, 0–210	152.2, 24.9, 0–210	154.6, 25, 0–206	0.06
Personality (M, SD, range)				
Extraversion	3.54, 1.57, 1–7	3.58, 1.57, 1–7	3.50, 1.57, 1–7	0.27
Agreeableness	2.43, 1.11, 1–6	2.40, 1.08, 1–6	2.46, 1.14, 1–6	0.25
Being conscientious	1.99, 0.98, 1–7	2.08, 1.04, 1–7	1.89, 0.91, 1–7	0.00
Being emotionally stable	3.34, 1.43, 1–7	3.40, 1.42, 1–7	3.28, 1.43, 1–7	0.07
Being open to new experience	3.08, 1.25, 1–7	3.08, 1.23, 1–7	3.07, 1.27, 1–7	0.86
Average sex in past 3 months				
Never	25%	26%	23%	0.14
Less than once a month	11%	12%	11%	0.51
Once a month	9%	8%	10%	0.14
Once every 2 weeks	16%	16%	16%	1.0
Once a week	20%	21%	18%	0.11
2/3 times a week	15%	13%	18%	0.003
4/6 times a week	3%	3%	3%	0.25
At least once a day	1%	1%	1%	0.44
G-spot	56%	56.6%	55.2%	0.48

DZ = dizygotic; MZ = monozygotic; SD = standard deviation.

Table 2 Results of the multivariate logistic regression analyses (including age, emotional intelligence, personality, social class, educational level, number of partners, and sex during past 3 months) on women reporting/not reporting a G-spot and various other variables related to sexual function and behavior

Presence of G-spot logistic regression

		Overall sample			Women <55			Women >55		
Question	Response scale	N	OR (95% CI)	*P* value	N	OR (95% CI)	*P* value	N	OR (95% CI)	*P* value
Overall, how frequently do you experience ***orgasm during intercourse***?	"Never" (1) to "Always" (7)	1,555	1.19 (1.12–1.26)	0.00	662	1.17 (1.08–1.29)	0.00	769	1.20 (1.12–1.30)	0.00
Overall, how frequently do you experience ***orgasm during intercourse***?†	Never, Always	323	3.95 (2.28–6.86)	0.00	156	3.19 (1.45–7.02)	0.00	130	4.76 (2.03–11.18)	0.00
Overall, how frequently do you experience ***orgasm during masturbation (not specified)***?†	Never, Always	1,555	1.19 (0.86–1.66)	0.29	405	1.14 (0.68–1.91)	0.62	415	1.21 (0.79–1.88)	0.37
Overall, how frequently do you experience ***orgasm during masturbation (not specified)***?	"Never" (1) to "Always" (7)	885	1.02 (0.98–1.08)	0.23	662	1.00 (0 .93–1.08)	0.91	769	1.04 (0.98–1.11)	0.18
Do you feel you have ***difficulty reaching orgasm***?	No/Yes	1,642	1.56 (1.22–1.99)	0.00	760	1.37 (0.91–2.05)	0.12	733	1.70 (1.24–2.33)	0.00
How often, if ever, do/did you experience ***multiple orgasms*** (i.e. two or more orgasms within a single episode of lovemaking)?	"Never" (1) to "Always" (7)	1,761	1.15 (1.06–1.25)	0.00	752	1.15 (1.03–1.29)	0.02	760	1.16 (1.03–1.29)	0.01
How difficult is/was it for you to reach ***orgasm through vaginal stimulation by partner***	"Impossible" (1) to "Not difficult" (56)	1,735	1.31 (1.20–1.44)	0.00	751	1.38 (1.21–1.59)	0.00	748	1.25 (1.11–1.41)	0.00
How difficult is/was it for you to reach ***orgasm through vaginal stimulation by yourself***	"Impossible" (1) to "Not difficult" (5)	1,731	1.28 (1.17–1.41)	0.00	747	1.03 (0.92–1.15)	0.62	722	1.01 (0.91–1.12)	0.79
How difficult is/was it for you to reach ***orgasm through penetrative sex*** without any other stimulation?	"Impossible" (1) to "Not difficult" (5)	1,741	1.20 (1.11–1.30)	0.00	754	1.26 (1.11–1.43)	0.00	748	1.16 (1.05–1.29)	0.00
How frequently, if ever, do/did you achieve ***orgasm through kissing***?	"Never" (1) to "Always" (7)	1,746	1.26 (1.09–1.46)	0.00	756	1.46 (1.15–1.85)	0.00	745	1.17 (0.98–1.41)	0.07
How frequently, if ever, do/did you achieve ***orgasm through petting***?	"Never" (1) to "Always" (7)	1,764	1.08 (1.02–1.15)	0.01	758	1.06 (0.97–1.16)	0.19	757	1.11 (1.02–1.20)	0.01
How frequently, if ever, do/did you achieve orgasm through ***breast stimulation*** only?	"Never" (1) to "Always" (7)	1,751	1.21 (1.08–1.36)	0.00	758	1.42 (1.14–1.78)	0.00	746	1.13 (0.99–1.31)	0.04
Overall, how ***satisfying*** is orgasm to you with a ***partner***?	"Not at all" (1) to "Extremely" (7)	1,746	1.12 (1.05–1.21)	0.00	754	1.17 (1.10–1.24)	0.00	748	1.17 (1.08–1.28)	0.00
Overall, how ***satisfying*** is orgasm to you with by ***self-masturbation***?	"Not at all" (1) to "Extremely" (7)	1,571	1.07 (1.02–1.13)	0.00	700	1.04 (0.99–1.09)	0.07	659	1.04 (0.90–1.05)	0.45
In general, how ***arousing*** do/did you find ***sexually explicit material***?	"Not at all" (1) to "Very" (4)	1,747	1.15 (1.07–1.24)	0.00	791	1.23 (1.07– 1.43)	0.00	760	1.00 (0.89–1.12)	0.99
How often, if ever, do/did you ***look*** at ***sexually explicit material***?	"Never" (1) to "Frequently" (5)	1,748	1.29 (1.13–1.49)	0.00	791	1.52 (1.17–1.98)	0.00	764	1.18 (0.94–1.48)	0.15
On average, how frequently do you have ***sexual thoughts or fantasies***?	"Never" (1) to "More than once a day" (6)	1,719	1.16 (1.08–1.25)	0.00	748	1.48 (1.18–1.86)	0.00	758	1.02 (0.87–1.21)	0.73
Does ***fantasizing*** help you experience orgasm?	"Never" (1) to "Always" (5)	1,764	1.06 (0.96–1.17)	0.20	761	1.06 (0.92–1.23)	0.39	759	1.07 (0.94–1.23)	0.27
Overall, how ***satisfied*** are you with your ***sexual experiences*** so far?	"Not at all" (1) to "Very Satisfied" (5)	1,684	1.34 (1.21–1.47)	0.00	754	1.31 (1.06–1.62)	0.00	743	1.22 (1.05–1.42)	0.01
Overall, how ***satisfied*** are you with your ***relationship*** so far?	"Not at all" (1) to "Very Satisfied" (5)	1,738	1.18 (1.07–1.29)	0.00	749	1.19 (1.07– 1.31)	0.00	741	0.85 (0.73–0.99)	0.04
Have you ever ***discussed your sex-life*** with your twin?	No/Yes	1,779	1.62 (1.25–2.10)	0.00	796	2.06 (1.39–3.07)	0.00	780	1.25 (0.88–1.79)	0.20

Note: Results are shown for the overall sample and for the two groups of women under age 55 and women above age 55.
CI = confidence interval; OR = odds ratio.

Table 3 Univariate logistic regression analysis of potential confounders for reported G-spot in the study population

Confounder	Odds ratio (95% confidence interval)	*P* value
Age (per year)	**0.98 (0.98–0.99)**	**0.00**
Social class (per unit increase)	1.11 (0.85–1.46)	0.42
Education level (per year)	1.00 (0.97–1.03)	0.94
Sex during past 3 months (per unit increase)	1.02 (1.01–1.09)	0.06
Number of partners (per increasing number of partners)	1.01 (0.99–1.03)	0.12
Emotional intelligence	1.002 (0.998–1.006)	0.147
Personality (per unit increase)		
Extraversion	**1.07 (1.01–1.14)**	**0.03**
Agreeableness	1.00 (0.92–1.09)	0.94
Being conscientious	0.98 (0.89–1.09)	0.75
Being emotionally stable	1.03 (0.96–1.10)	0.39
Being open to new experience	**1.14 (0.99–1.19)**	**0.00**

Note: Significant results are shown in bold.

difficulty achieving orgasm through clitoral stimulation compared with vaginal stimulation between women reporting and not reporting a G-spot. Unpaired two-tailed *t*-tests were used to test for differences between MZ and DZ twins for age, education, and number of partners. Differences in marital status, number of partners, average sex in the last 3 months, and reported G-spot frequency between DZ and MZ twin pairs were also assessed.

For all analyses, a *P* value less than 0.05 or odds ratios with a 95% confidence interval not including "1" were considered statistically significant, unless stated otherwise. All data handling and analyses were undertaken using STATA (Version 10.0, 2008, StataCorp, College Station, TX, USA). Genetic modeling was carried out with Mx software (MC Neale, 1998, 3rd Ed., Richmond, VA, USA) [31].

Twin Data and Genetic Modeling

The twin model is the classic epidemiological design increasingly used in human behavioral genetics to study the sources of population variation in a phenotype, thereby delineating genetic from environmental factors. The twin design assumes that MZ twins share 100% of both their genes and shared environment, whereas DZ twins share, on average, 50% of their genes and 100% of shared environment. Presuming that both types of twins share equally similar family environments, any greater similarity between MZ as compared with DZ twin pairs is attributed to genetic factors [32].

Standard methods of quantitative genetic analysis were used to model latent genetic and environmental factors influencing sibling covariance for MZ and DZ twins. Evidence for a genetic contribution (heritability) can be obtained by comparing case-wise concordance (CR) for a dichotomous trait of interest in MZ and DZ twins. CR describes the probability that a twin is affected, given that the co-twin is affected. The CR is calculated from (i) the number of concordant pairs and discordant pairs (ii) using the formula $CR = 2c/(2c + d)$ [33]. For dichotomous traits such as the reported existence of a G-spot, the maximum likelihood modeling method was used. This assumes that variation in the underlying liability of the dichotomous trait is normally distributed in the population. The correlation in liability among twins is estimated from the frequencies of concordant and discordant pairs using a multifactorial liability threshold model [34]. The level of association within MZ and DZ twin pairs can be further measured by employing tetrachoric correlations coefficients, given the assumption that the trait is discrete in expression but has an underlying continuous distribution.

When a significant twin correlation for a trait suggest the presence of a genetic influence, quantitative genetic model fitting can be used to assign observed phenotypic variation to additive (A) and dominant (D) genetic effects and common (C) and unique environmental (E) effects [35]. The common environmental component estimates the contribution of family environment, whereas the unique environmental component estimates the effects that apply only to each individual, including measurement error. Initial assessment of the components (A, D, C, and E) may suggest nonsignificant values in one or more component. Further analysis can determine the significance of each factor as components of the observed variance by removing each sequentially from the full model and testing the deterioration in fit of the various submodels using hierarchic chi-square tests. The most parsimonious model is then used to estimate the heritability, which is defined as the proportion of total phenotypic variation in a population that is attributable to genetic variation among individuals. This method has been widely used for over 2 years and has been reported in many publications from the Department of Twin Research (http://www.twinsuk.ac.uk).

Results

A total of 1,875 individuals returned the questionnaire, a response rate of 40.5%. Not every participant answered every item. Only questionnaires

Table 4 Case-wise concordance rates for G-spot in MZ and DZ twins

	Total*	Discordant	Concordant	Case-wise concordance 95% CI	Tetrachoric correlation 95% CI
MZ	868	165	116	58% (53–64)	0.111 (–0.05–0.27)
DZ	936	161	121	60% (54–66)	0.126 (–0.04–0.28)

*Note: The sum of concordant and discordant twins may not equal the total sample number a result of one or both in a twin pair failing to respond to the question. DZ = dizygotic; MZ = monozygotic; CI = confidence interval.

that included a response to the G-spot question were used in the analysis. Women who reported that they were homo- or bisexual were excluded from the study because of the common use of digital stimulation among these women, which may bias the results. Also excluded were women who had never engaged in vaginal intercourse. After applying exclusion criteria 1,840 women were eligible (aged between 23 and 83, with a mean age of 55.2; Table 1), comprising 357 complete MZ pairs and 356 complete DZ pairs and 378 women whose co-twins did not participate (21.1%). The sample of respondents did not appear to be biased by age as the average age of all respondents was 55 years, compared with an average age of 53 years for all twins to whom the questionnaire was sent.

Over half the women in our study (56%) reported having a G-spot (Table 1). Age was found to have a substantial influence on G-spot reporting ($P < 0.001$) with older women less frequently reporting the existence of a G-spot compared with younger women (e.g., 53% of women over 60 compared with 63% of women under 40). In addition, women scoring higher on the personality domains "extraversion" and "openness to new experience" were significantly more likely to report having a G-spot (OR 1.07, $P < 0.05$; OR 1.14, $P < 0.001$). Other potential confounders including social class, education levels, other aspects of personality, emotional intelligence, number of partners, and frequency of sex during the past 3 months were not significantly associated with reporting a G-spot in our sample. However, we still included them in our multivariate analysis, because numerous other studies indicated their mediating effects on female sexual function [4,5,36,37].

CR rate for the existence of a G-spot was not significantly higher in MZ than DZ twins as shown in Table 4; thus, no heritability could be expected (58% vs. 60%, $P > 0.01$). The correlations between twins, measured by tetrachoric correlation coefficients (r) were very similar, pointing to shared environmental influences (rMZ = 0.11, rDZ = 0.12) (Table 4). Both tetrachoric correlations were nonsignificant, indicating that even the influence of C would not be significant. Hence, a model including only unique environment (E) would likely fit the data.

The results of quantitative genetic model fitting are shown in Table 5. Variance component modeling revealed that a CE model—ascribing the total variance in liability to report a G-spot to common and unique environmental factors and random error—was the best fitting, most parsimonious model, suggesting that nonshared environment and random error account for up to 89% of the total variation in G-spot reporting with the genetic component having a minimal influence. The effects of the common environment and dominant genetic effects could be dropped from the full model without significant loss of fit. Estimates from this model resulted in no heritability for G-spot reporting.

Table 5 Model fitting results for univariate analysis of G-spot

Model	A (95% CI)	C/D (95% CI)	E (95% CI)	χ^2 (df)	P value	AIC
G-spot n = 1426						
ACE	0.00 (0.00–0.26)	0.11 (0.00–0.23)	0.89 (0.74–1.00)	4.624 (3)	—	—
AE	0.13 (0.00–0.27)	—	0.87 (0.73–1.00)	5.232 (4)	0.436	–1.392
CE	**—**	**0.11 (0.00–0.23)**	**0.89 (0.77–1.00)**	**4.624 (4)**	**1**	**–2.000**
E	—	—	1.00 (1.00–1.00)	8.291 (5)	0.160	–0.333

Note: Best-fit model is set in bold.
A = Additive genetic effects; D = Dominant genetic effects; C = Common environmental effects; E = Unique environmental effects and random error; The variance component E is conflated with the random error in the ordinary least squares regression and therefore the confidence intervals for E cannot be explicitly estimated using DF methods. However, the point estimate for E can be estimated by subtracting the other estimated variance components from 1. AIC = Akaike Information Criterion. AIC describes the model with best goodness-of-fit combined with Parsimony. The submodel with the lowest AIC is the best fitting; df = change in degrees of freedom between submodel and full model; χ^2 = chi-square goodness-of-fit statistic; P = probability that $\Delta\chi^2$ is zero; CI = confidence interval.

As in other surveys, our female twins reported experiencing orgasm more frequently through masturbation (technique not specified) compared with vaginal penetration [25,38]. In addition, women were more able to achieve orgasm through various methods of clitoral stimulation rather than by vaginal stimulation by their partner (results not shown). This was also true whether or not women reported a G-spot (clitoral self vs. digital vaginal self stimulation $P < 0.001$; clitoral stimulation by partner vs. penile penetration $P < 0.001$) (Figure 1).

Further analysis revealed that women who report orgasm during intercourse 100% of the time were more likely to report a G-spot than women who never orgasm (OR = 3.95, $P < 0.001$; Table 2). Nonetheless, 50.1% in this category did not report a G-spot. Women reporting a G-spot also reported more frequent orgasm through kissing, breast stimulation, and petting (OR = 1.26, $P < 0.001$; OR = 1.21, $P < 0.001$; OR = 1.08, $P < 0.01$). Women experiencing multiple orgasms reported a G-spot significantly more often than women who do not (OR = 1.15, $P < 0.001$). Overall, women reporting a G-spot found their orgasm more satisfying (OR = 1.12, $P < 0.001$) and were slightly more likely to have an orgasm through penetrative sex by partner than women who did not report having a G-spot (OR 1.26, $P < 0.001$) (Figure 2). However, women with a reported G-spot still preferred clitoral rather than vaginal orgasm (41.8% vs. 26.81% respectively, $P < 0.001$).

Overall, women who were more satisfied with their sexual experiences and with their relationship with their partners were more likely to report a G-spot (OR = 1.34, $P < 0.001$; OR = 1.18, $P < 0.001$, respectively), even after adjusting for other factors. This was also true for women who fantasize more about sex, are more comfortable with erotic material and talking about sex-related issues (OR = 1.16, $P < 0.001$; OR = 1.15, $P < 0.001$ and OR = 1.62, $P < 0.001$, respectively) (Table 2).

Discussion

To our knowledge, this is the first study to investigate whether there is a genetic basis to the G-spot. The finding that phenotypic variance in self-reporting of a G-spot is almost entirely a result of unique environmental factors and random error with hardly any genetic influence not only refutes the assumption that there is a physiological or physical basis to this specific phenotype,

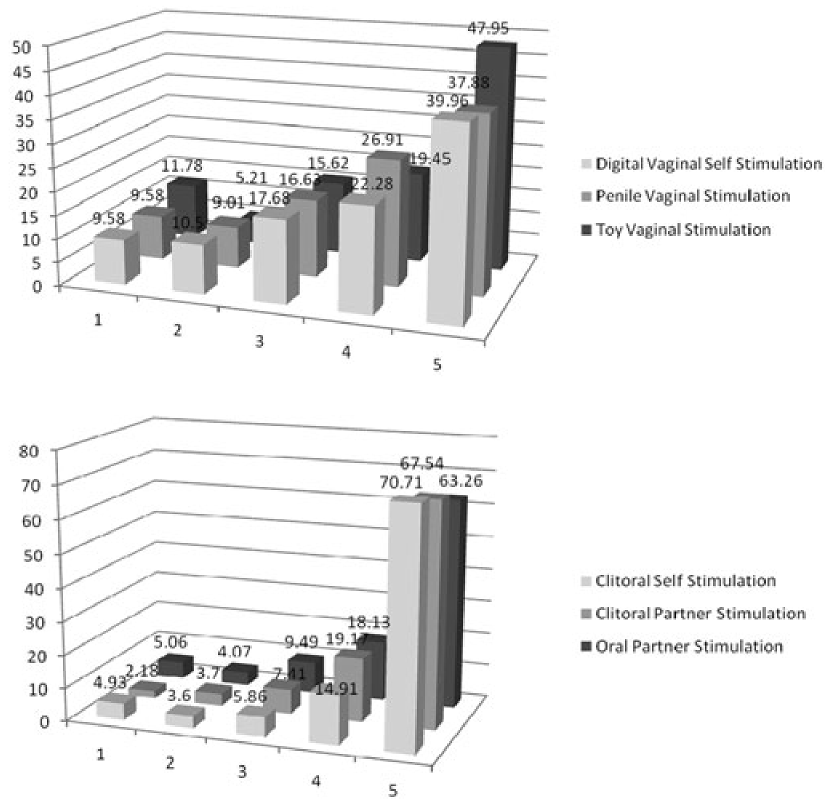

Figure 1 Graph bar indicating the difficulties of experiencing orgasm through various ways of clitoral (self, partner, oral) and vaginal (digital self, penile, toy) stimulation in women reporting a G-spot (n = 994). Despite reporting a G-spot women still find it significantly less difficult to experience orgasm via different forms of clitoral stimulation compared with vaginal stimulation (response percentages are indicated on the y-axis; the x-axis represents the response scale 1 to 5 = not difficult at all to very difficult).

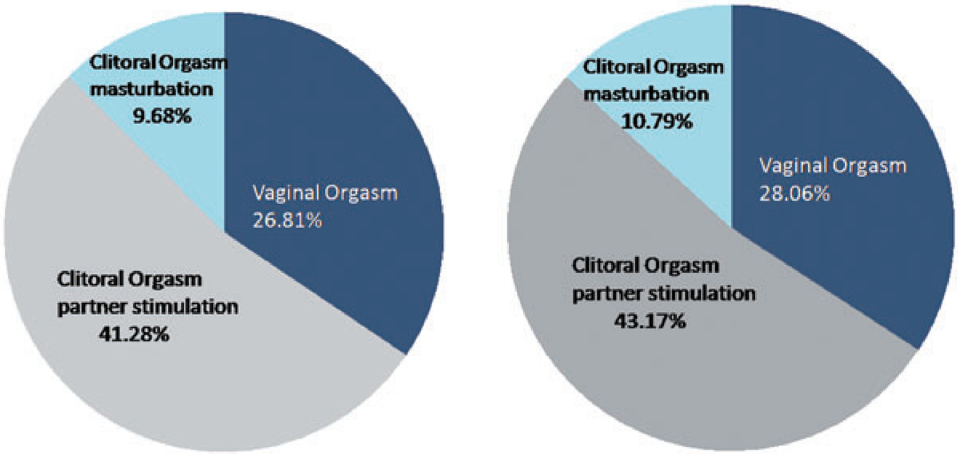

Figure 2 Graph pie indicating preferences in clitoral and vaginal stimulation in women reporting having a G-spot (left) vs. women who do not (right). Women reporting a G-spot still show a significantly higher preference for clitoral orgasm compared with vaginal orgasm (41.28% vs. 26.81%, $P < 0.001$).

but also leads to a range of possible alternative explanations.

True physiological, anatomical, and biochemical characteristics that show variability are always at least partly heritable. This might lead us to assume that the G-spot is (i) either unmeasurable in women by self-report, (ii) a very rare or nonexistent anatomical occurrence, or (iii) a possible sensation resulting from a high level of general stimulation but not in a specific area.

There are other observations in our study supporting the assumption that the G-spot may be a rare or nonexistent biological phenomenon. The prevalence rates for self-reporting of a G-spot in our study (56%) significantly exceed the rate reported in the literature by women who are able to experience vaginal orgasm (around 15–30%) [3]. If there was a G-spot, then it is reasonable to expect that women reporting one would have a higher rate of orgasm through penetration.

Evidence from various studies has shown that the G-spot is only stimulated by vaginal penetration in a few positions, and that digital or vibrator stimulation by the woman herself or by her partner is more likely to stimulate the G-spot. However, as shown in Figure 1, women reporting a G-spot still find it easier to achieve orgasm by various methods of clitoral stimulation (self, partner) compared with various types of vaginal penetration (digital, penile, sexual equipment). Hence, it seems that the hypothetical G-spot is neither necessary nor sufficient for a woman to experience a vaginal orgasm, providing legitimate grounds to further question its existence. Rather, it seems that a woman's perception of having a G-spot is a function of nonphysiological factors.

Most women will have read articles about the G-spot in the media and discussed it with peers that could explain the age correlations. Also, women who report a G-spot seem to be generally more easily aroused and have a higher susceptibility to sexual stimuli, as they not only find it slightly easier to experience orgasm through penetration but also report significantly more frequent and satisfying orgasms and more frequent occurrence of multiple orgasms. Furthermore, they find sexually explicit material more arousing and are more comfortable in speaking about sexuality related issues with their co-twin, which suggests a more relaxed and open attitude toward sexuality.

We found the personality domains "extraversion" (interest in seeking out excitement) and "openness to experience" (active imagination, attentiveness to inner feelings, preference for variety) to be significantly associated with reporting a G-spot. Surprisingly, we were unable to find a significant effect of emotional intelligence, which has been previously shown to be associated with female sexual behavior, on G-spot reporting [5]. Overall these findings support our conclusion that psychosocial factors such as individual differences in personality, rather than physiological factors, influence a woman's perception of having a G-spot rather than physiological factors.

Lastly, women reporting a G-spot are considerably more satisfied with their partner relationship than women who do not report the presence of a G-spot. They are also more likely to experience orgasm through penetration and are easily aroused. This could blur their perception and lead them to assume that they have a highly specific erogenous area in their vagina.

Another explanation for the absence of genetic effects in this study is the nature of the self-reported questionnaire design. Many women may not be acquainted with anatomical notions and therefore an erroneous interpretation of the question could introduce a methodological bias. Women's understanding of the terminology in the question used in our study might be moderated by educational factors and the lack of relevant sexual education. However, we did not find an association between education and G-spot reporting in our sample (OR 0.99, $P > 0.5$). Also there was no significant difference for years of education in women reporting a G-spot compared with women who did not (mean 10.5 vs. 10.4, $P > 0.5$; results not shown).

The only other large population study of self-reporting of a G-spot was based on 1,245 women aged 22–82 from the United States and Canada. This study reported a prevalence of 65%, similar to the prevalence rate obtained in this study (56%) [39,40]. This suggests an equivalent accuracy of the definition used in that study ("perception of an especially sensitive area in their vagina which, if stimulated, produces pleasurable feelings"). This supports the argument that a self-reported G-spot—the popular conception of the G-spot—does not appear to exist. However, we can not rule out the possibility that future studies using a more detailed definition of the G-spot as suggested by Komisaruk et al., may yield different results and prevalences [2].

So, while the results of our study suggest that a self-reported G-spot is not heritable puts doubt on its existence, it might be that objective measurement of anatomical variability is the only valid way to assess the actual existence of a G-spot. If the existence of a true G-spot is rare compared with a self-perceived G-spot, then this would significantly dilute the results of the heritability analyses. Several studies have suggested that gynecologists and women can be trained to manually detect the G-spot, but recruiting the necessary numbers for a population-based heritability study may not be viable [13,19,21].

There are several other possible limitations to this study. Our response rate (40%) was relatively low compared with other medical surveys, but similar to other sex surveys. However, a low response rate does not necessarily mean that the results are biased. There may be a recall bias in recalling G-spot in those women currently sexually inactive. The generalizability of the results may be limited as a random sample of the general population was not used. However, the considerably high rate of women reporting a G-spot (56%) combined with infrequent to complete absence of orgasm (approximately 30%) corresponds to the prevalence for these phenotypes found in the current literature and implies that the results obtained in this study are not biased and may be generalizable [25,38]. Our stratified analysis dividing women in two groups of under and above 55 years of age showed that the results of our various regression models seem to be similar across the two age groups (Table 2).

The representativeness of twins is worth considering. An extensive comparative study on our twin sample, however, has shown our twin population to be very similar to singletons for a wide range of common health and lifestyle factors. Therefore, the conclusion derived from our study should be generalizable to the general population [27]. In addition, we also accounted for the family structure of the twins in our analysis and we had adequate power to exclude a genetic influence as low as of 5% if it had been present.

Although the twin method is now universally accepted by geneticists, it was in the past controversial. It was claimed in the 1960s and 1970s that the twin model exaggerated genetic influence at the cost of environmental effects—particularly for tests of intelligence—because the design is based on the "Equal Environments Assumption" (EEA), a concept implying that the effects of the environments of the MZ and DZ twin pairs being compared are equivalent. Arguing that MZ twins experience a more similar environment than DZ twins would mean that MZ correlations should be higher than DZ correlations—even in the absence of genetic influences—as a result of a greater environmental similarity among MZ twins. However, there is plenty of evidence to suggest the EEA does hold. In our case, our findings show DZ twins to be as similar as MZ twins (Table 1). Moreover, a wealth of data from other sources such as twins reared apart, twins misclassified as identical, comparison with family studies, and recent direct genotyping ignoring the twin model assumptions have shown the twin model to be a robust estimate of the genetic influence on a trait [41].

Conclusion

This large-scale twin study can be seen as a substantial contribution to the current debate on the existence of the G-spot, adding to other research findings. Our main conclusion is that there is no genetic basis to the self-reported G-spot, suggesting that the G-spot is rather a perception created by nonphysiological factors that can cause a heightened sexual sensation.

Future studies investigating the G-spot should focus on anatomical assessment methods like ultrasonography in as large a population base as possible, or consider a questionnaire or interview with a more detailed definition of the phenotype. Assuming our conclusions are correct, research should also explore other reasons for the wide variation in orgasmic experiences and sexual dysfunction, e.g., the brain, behavioral and psychological traits, and anatomical studies on the anterior vaginal wall and other sexual organs like the clitoris that show wide variability in size and position [42,43].

Investigating these other factors associated with heightened sexual sensations may have implications for psychosexual education and treatment approaches, where women who are not able to climax through vaginal penetration alone could finally end up feeling less inadequate or underachieving.

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