

Brief Reports

SEXUAL ORIENTATION OF HUMAN OFFSPRING MAY BE ALTERED BY SEVERE MATERNAL STRESS DURING PREGNANCY

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To test the hypotheses that maternal stress during pregnancy may alter the sexual orientation of offspring, 285 women with offspring 19 years of age and older provided retrospective accounts of stressful experiences they had, beginning 12 months prior to pregnancy up to the point of giving birth, and indicated how severe they recalled each event being. When weighted according to severity, stressful experiences helped to predict sexual orientation of male offspring. While most of the variance in sexual orientation remained unexplained, the data suggest that the most critical time in gestation for influencing human sexual orientation of male offspring is during the second trimester, although the first and possibly the third trimesters may be of secondary importance. For female offspring, no significant relationships between maternal stress and sexual orientation were found, although mothers of lesbians did report slightly higher average levels of stress throughout gestation than mothers of female heterosexuals.

KEY WORDS: sexual orientation, maternal stress, homosexuality, bisexuality, pregnancy.

The causes of homosexuality, as well as less extreme inversions of sexual orientation (varying degrees of bisexuality), have been debated for centuries (West, 1977). Evidence was recently reviewed to support the view that prenatal neurohormonal factors are the main determinants of variations in sexual orientation (Ellis & Ames, 1987). Among the prenatal factors that were hypothesized to affect sexual orientation is maternal stress. Basically, such effects appear to emanate from so-called *stress hormones* (e.g., corticosterone, adrenaline), which are synthesized and released by the mother during stressful experiences. After crossing the placental barrier, these hormones temporarily interfere with fetal production of various sex hormones, especially testosterone (Heritage, Stumpf, Sar, & Grant, 1980; Ward & Weisz, 1984). Should this disruption occur when crucial brain parts controlling sexual orientation are being sexually differentiated, permanent inversions could occur (although the

The authors are grateful to Ingeborg L. Ward and Alan Witmayer for providing helpful criticisms of drafts, and to Heather Ellis, Ron Sholley, Joan Stroschein, and Eric Woodard for providing vital assistance in data collection and coding.

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behavioral effects of these inversions may not fully manifest themselves until several years following puberty) (Durden-Smith & DeSimone, 1983).

Evidence supporting this *maternal stress hypothesis* is limited primarily to (1) a series of studies of rodents, in which males born to severely stressed mothers have been found to sexually present to other males to an unusual degree (reviewed by Ward, 1984), and (2) two correlative studies among humans suggesting that mothers of male homosexuals experienced greater average levels of stress during pregnancy than mothers of male heterosexuals (Dorner et al., 1980; Dorner, Schenk, Schmiedel & Ahrens, 1983). However, the latter two studies have been severely criticized for several methodological shortcomings (Feder, 1984).

The present study was undertaken to test the maternal stress hypothesis among humans in a way that avoided some of the methodological shortcomings of the two studies reported by Dorner and associates. Besides wanting to determine if maternal stress during pregnancy was predictive of sexual orientation inversions, we also attempted to identify when during gestation fetuses were most vulnerable to inversions in sexual orientation. Various lines of evidence lead us to predict that the second trimester would be especially crucial in this regard (Ellis & Ames, 1987).

Method

The subjects for this study consisted of 283 mothers and their offspring, recruited primarily through students at Minot State University, but also through national support organizations for persons with lupus erythematosus and for parents of gays, and from a mailing to random samples of names in several large U.S. city telephone directories (see Ellis, Burke, & Ames, 1987).

Mothers ranged in age from 36 to 77 years, with a mean of 51.5 ($SD = 8.6$). Offspring ranged in age from 19 to 50 years, with a mean of 25.5 ($SD = 6.5$). Nearly all of the mother/offspring pairs (98%) were Caucasian, and 56% of the offspring listed north-midwestern states as their place of birth, with the remainder scattered fairly evenly throughout the rest of the United States.

Mothers were not informed of the purpose of the study beyond being told that it had to do with assessing the possible effects of stress and other social and emotional experiences upon the health and behavior of their offspring. Mothers responded to a 6-page questionnaire, three pages of which were devoted to inquiries about emotional stress, particularly during and for the year preceding their pregnancy with the offspring who completed the companion form. On two of the three pages pertaining to stress, a table appeared containing a list of 31 potentially stressful events down the left hand margin. Along the top of the table were listed seven 3-month "reference periods," beginning with 9-12 months before pregnancy, and concluding with the third trimester of pregnancy. Beside each stressful experience listed, mothers were instructed to indicate in which of the seven 3-month periods they had felt stress, and to use a numeric code to indicate the severity level—ranging from 1 (meaning "not significantly affected") to 4 (meaning "greatly affected"). Otherwise, the mother's questionnaire largely pertained to the mothers' entire pregnancy history, as well as many health-related issues.

The sexual orientation of nearly all of the offspring was determined by responses on a separate matched questionnaire in which offspring reported the percentage of time they imagined sexual relationships with a member of their own sex (see Ellis et al., 1987). In 14 cases, we had maternal forms from mothers who were members of a parents of gays support group, but no offspring form. Based upon other male offspring forms received through this organization, we were able to assume that the sexual orientation of the offspring was strictly homosexual.

For the present analysis, the following five groups of offspring were designated: (1) 68 heterosexual males who never fantasized about sexually interacting with the same sex, (2) 14 bisexual males who sexually fantasized about the same sex between 1% and 99% of the time, (3) 39 homosexual males who always fantasized about the same sex, (4) 134 heterosexual females who never sexually fantasized about their own sex, and (5) 28 lesbians who sexually fantasized about their own sex 1% to 99% of the time.

Results and Discussion

Table 1 presents (a) mean stress incidences reported by mothers, and (b) mean stress incidences times the severity code (henceforth, called *stress severity*), according to the sexual orientation of offspring. It shows that mothers of male homosexuals reported greater average stress incidences and stress severity scores than mothers of the other four groups in the year prior to pregnancy, but not *during* pregnancy. In fact, during pregnancy, mothers of male bisexuals and mothers of lesbians exceeded mothers of male homo-

Table 1

Mean Stress Incidence and Stress Severity Reported by Mothers Before and During Pregnancy According to Sex and Sexual Orientation of Offspring

	Total Sample (<i>N</i> = 283)	Male Hetero- sexual (<i>N</i> = 68)	Male Bisexual (<i>N</i> = 14)	Male Homo- sexual (<i>N</i> = 39)	Female Hetero- sexual (<i>N</i> = 134)	Female Lesbian (<i>N</i> = 28)
Year Prior to Pregnancy						
Mean incidence	1.8	1.7	1.6	2.7	1.8	1.4
Mean stress severity	5.1	4.3	3.3	8.0	5.0	4.3
During Pregnancy						
Mean incidence	2.2	2.2	2.6	2.5	2.1	2.6
Mean stress severity	5.9	5.0	6.5	6.9	5.7	7.1
Overall Stress Throughout Reference Period						
Mean incidence	4.0	3.9	4.3	5.2	3.9	4.0
Mean stress severity	11.0	9.4	9.8	14.9	10.7	11.6

sexuals in average stress incidences, although differences were not statistically significant. Table 1, therefore, does not support the view that mothers of male homosexuals differ from other mothers in their overall levels of stress during pregnancy.

Only when the stressful events were weighted by the mothers' severity estimates for each 3-month time frame did evidence supporting the maternal stress hypothesis emerge. Table 2 shows the average stress severity scores for mothers of all five offspring groups for all seven time frames. After comparing each row of means, *t*-tests were used to calculate the probability of the most disparate pair of means in each row being due to chance. Two pairs of means were found to be significantly different from one another beyond the .05 level, and both involved mothers of male homosexuals compared to mothers of male heterosexuals. First, during the second trimester the average stress severity score was nearly twice as high for mothers of male homosexuals as for mothers of male heterosexuals. Since this was predicted, a one-tailed test of significance was applied, rendering significance at the .05 level ($t = 1.66$).

Second, during the 9-12 months prior to conception, mothers of homosexuals had over two and one-half times as high severe stress scores as mothers of heterosexuals. Because this specific difference was not expected, a two-tailed test was used, yielding significance at the .03 level ($t = 1.90$).

A post hoc explanation for this latter significant finding is as follows: an average delay of over 25 years in the mothers' recall of stress during pregnancy, no doubt, is responsible for considerable random error in the data. In addition to random error, the data may contain systematic error due to a phenomenon known as *telescoping*. When survey respondents are asked to recall events occurring within a bounded time frame, they have a tendency to move forward relevant events which occurred prior to the reference period (Skogan, 1978). In accordance with our hypothesis, we suspect that mothers of male homosexuals did experience unusually high levels of stress not only during pregnancy (and possibly during some of the year preceding pregnancy), but even prior to the reference period. The high level of stress reported by these mothers during the 9 to 12 months prior to pregnancy, therefore, may reflect a telescoping effect from stress experience even earlier.

Other findings that may be relevant to the maternal stress hypothesis revealed in Table 2 are these:

Even though it was only significant at the .12 level (one-tailed test; $t = 1.17$), the average stress severity score was nearly twice as high during the first trimester for mothers of male homosexuals as it was for mothers of male heterosexuals.

Although not statistically significant, mothers of male homosexuals reported less severe stress in the third trimester than mothers of male heterosexuals and mothers of male bisexuals.

Table 2 presents the average stress severity scores reported by mothers of female heterosexuals and lesbians throughout the reference period. Statistical tests revealed no significant differences between the stress severity measures of mothers of these two groups of offspring. Nevertheless, during all three trimesters of pregnancy, mothers of lesbians reported somewhat higher levels of severe stress than mothers of female heterosexuals.

In conclusion, although this study must be considered exploratory, it provides some support for the maternal stress hypothesis, at least regarding male homosexuality. Because of the methodological obstacles involved (e.g., retrospective reporting, absence of bio-chemical assessment, etc.) more definitive research along these lines is in order.

Table 2

Mean Stress Severity Reported by Mothers for Three-Month Periods, Beginning a Year Prior to Pregnancy According to Sex and Sexual Orientation of Offspring

	Male Hetero- sexual (N = 68)	Male Bisexual (N = 14)	Male Homo- sexual (N = 39)	Female Hetero- sexual (N = 134)	Female Lesbian (N = 28)
9-12 months before pregnancy					
Mean	1.43	1.50	3.85*	1.81	1.62
S.E.	.38	.60	1.22	.32	.45
6-9 months before pregnancy					
Mean	.79	.64	1.31	.70	.82
S.E.	.29	.34	.43	.20	.38
3-6 months before pregnancy					
Mean	.71	.43	1.46	1.16	.61
S.E.	.18	.29	.44	.24	.31
0-3 months before pregnancy					
Mean	1.35	.71	1.38	1.29	1.21
S.E.	.40	.44	.50	.27	.52
1st trimester of pregnancy					
Mean	1.54	1.64	2.79	1.89	2.26
S.E.	.35	.67	1.01	.33	.84
2nd trimester of pregnancy					
Mean	1.16	1.86	2.31**	1.49	1.81
S.E.	.32	.69	.61	.27	.67
3rd trimester of pregnancy					
Mean	2.26	3.00	1.82	2.26	2.89
S.E.	.47	1.28	.52	.32	.91

*Significantly different than male heterosexuals at the .03 level (2-tailed test).

**Significantly different than male heterosexuals at the .05 level (1-tailed test).

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