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## HANDEDNESS, DYSLEXIA AND TWINNING IN HOMOSEXUAL MEN

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A study of handedness, dyslexia, stuttering and twinning, was included in a study of sexual habits of homosexual men. A questionnaire was mailed to homosexuals, and 394 forms suitable for data analysis were received. The results showed an increased rate of lefthand writing (17.5% compared to 8–8.4%), and a clear left shift. There were increased occurrence of both stuttering (7.1% compared to 1.6%) and reading difficulties (7.9% compared to 1–3%). The incidence of twins was lower than the population (1.3%). The results confirm earlier attempts to show a left shift in homosexuals, and support Geschwind's hypotheses about etiological factors for both lefthandedness and homosexuality.

*Keywords: Handedness, dyslexia, twinning, homosexuality, stuttering.*

It has been hypothesized that the left shift in laterality is based on an increased growth of the right hemisphere during fetal life. In addition, it has been hypothesized that increased levels of intrauterine testosterone is an important factor in this right hemisphere development, and eventually to a left shift in laterality (Geschwind and Galaburda, 1985a).

Several other disturbances should be related to this left shift, among others, stuttering and reading difficulties (Geschwind and Galaburda, 1985a).

Testosterone may also be involved in the etiology of homosexuality (Geschwind and Galaburda, 1985b; Ward and Weisz, 1980). In the case of homosexuality, however, a lower level of testosterone during fetal life is supposed to be the mechanism (Geschwind and Galaburda, 1985a; for a review see Rickett, 1984).

One factor, important for changes of intrauterine testosterone levels, is stress to the mother. Dörner et al. (1980) who studied 865 homosexuals in Eastern Germany reported that there was a higher occurrence of homosexuals born during the period 1940–45, i.e., during the Second World War. In a further study, Dörner et al. (1983)

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compared 100 homo- and bisexual men to 100 heterosexual men, and found a higher incidence of maternal stress in the homosexuals.

Based on this research, Geschwind and Galaburda (1985b) speculated that maternal stress, and intrauterine testosterone changes should both lead to a higher rate of lefthandedness and homosexuality (cp. McManus & Bryden, 1991).

It seems paradoxical that maternal stress could be associated with both increased and decreased levels of testosterone, and that this should operate on the same individual. However, Ward and Weisz (1980) showed that rats exposed for stress showed an increase in intrauterine testosterone levels in early pregnancy, but a decrease in mid-pregnancy (rats showed an increase on day 17, and a decrease on day 18–19). Control rats had a small increase on day 17, but no decrease. These changes in intrauterine testosterone levels could underpin the dual hypothesis by Geschwind and Galaburda (1985b) that maternal stress could cause increase in both homosexuality and lefthandedness (James, 1989).

Geschwind and Galaburda (1985b) also pointed to the increased occurrence of lefthandedness among twins (Boklage, 1984), as support of an assumption that they are exposed to testosterone *both* from the mother *and* the co-twin in fetal life. Thus, we deduce that lowered testosterone levels, with following homosexuality, should be less common among twins.

In the present study, it was hypothesized that there is a higher occurrence of left-handedness (and nonrighthandedness) in a sample of homosexual men, than in the general population. Furthermore it was hypothesized that there is an increased occurrence of stuttering and reading problems. The occurrence of twins, however, was hypothesized to be lower than in the general population.

## METHODS

### *Subjects*

The subjects were all respondents in the continuing AIDS Behavioral Research Project at UCSF (McKusick et al., 1985, 1990). This project was originally designed to determine how the AIDS epidemic was influencing gay men's psychological adjustment and sexual behavior. The subjects were, in order to get a diversity of gay lifestyles, recruited from four sites: (1) Gay bars, (2) bathhouses, (3) by advertising in gay newspapers and flyers to gay organizations, and (4) couples who had participated in an earlier investigation. In a new study, during Fall 1988, questionnaires about sexual habits were mailed to the same respondents with the questionnaire of the present study attached. It was sent to 810 respondents, and 575 returned the main questionnaire. We received 399 questionnaires, of which 394 were suitable for data analysis. As our form was attached to the main AIDS form, this yields a response rate for the present study of 69.4%.

The demographic data are not related to our subjects on an individual basis (on delivery our form was detached from the rest for confidentiality reasons), but the entire group has the following demographic characteristics (see also Table 1): The majority (68.1%) had some college; most (76.5%) also were in white collar or professional occupations. The mean reported income was \$24,000 per year.

### *Handedness Questionnaire*

The Edinburgh 22-item lefthandedness questionnaire, was used to assess handedness (Oldfield, 1971). The standard procedure suggested by Oldfield was used, giving five response categories: L++, L+, L = R, R+, R++.

TABLE 1.  
Demographic and health characteristics of the sample ( $N = 655$ ) the subjects were drawn from (McKusick et al., 1985, 1990). Status 1984 if not otherwise indicated.

Item	Value
Mean age (range 19–63) 1988	35.7
Percent white	91.2
Mean annual income (1000\$)	24.1
Percent some college	68.0
Percent professional/white collar	76.5
<i>Relationship status:</i>	
Percent single	44.5
Percent in relationship	37.9
Percent monogamous relationship (for whole period)	9.7
Percent nonmonogamous relationship	57.7
Other	17.5
Antibody HIV status (% positive) 1988	29.9
Antibody HIV status (% negative) 1988	39.0
AIDS (% prodromal symptoms)	17.3

The five activities writing, drawing, throwing a ball, using a scissors, and using a toothbrush (items no. 1, 2, 3, 4, and 6) were used to categorize the subjects into four handedness groups, according to Lansky et al. (1988):

Lefts (always use the left hand for all five activities); Left Mixeds (always write with the left hand but do any other activity with the right hand or write most of the time with left hand); and the corresponding Rights and Right Mixeds. The Mixed groups also included persons who used both hands equally to write but did the other activities primarily with the left or right." (p. 466–67)

### *Other Questions*

In addition, the subjects were asked if they were twins, and if they now or previously had had problems with stuttering or reading difficulties (yes or no answers).

### *Statistics*

Chi<sup>2</sup> tests, and differences between percentages ( $z$  values) were computed.

The study was approved by the Institutional Review Board of the University of California San Francisco; a Certificate of Confidentiality was also obtained from the National Institute of Mental Health (US Department of Health and Human Services) further to protect the respondents.

## RESULTS

*Handedness* Of the subjects, 17.5% reported that they always wrote with their left hand, while 74.9% always wrote with their right hand. Similar figures appeared for drawing, while the tendency for the rest of the items was a comparably high left preference, but somewhat more mixed use, and relatively low consistent right hand use (see Table 2).

In the present study, 6.9% were consistent Lefts according to the (5-item) procedure of Lansky et al. (1988), compared to 3.2 in the normal material on white,

TABLE 2  
Distribution of responses for the 22 items of the Edinburgh inventory

Item	L++	L+	L = R	R+	R++
1. Writing	17.5	0.5	0.3	6.9	74.9
2. Drawing	17.0	1.3	1.3	7.1	73.4
3. Throwing	13.7	2.3	4.3	15.5	64.1
4. Scissors	10.7	2.0	4.8	17.5	65.0
5. Comb	9.9	4.8	14.5	25.6	44.9
6. Toothbrush	12.7	3.0	9.6	22.1	52.5
7. Knife (without fork)	9.9	2.5	9.1	23.1	54.3
8. Spoon	11.9	2.8	8.4	26.9	49.7
9. Hammer	12.9	2.0	5.1	19.0	60.9
10. Screwdriver	10.2	3.8	12.2	21.9	51.9
11. Tennis racket	10.2	2.3	4.1	17.3	53.3
12. Knife (with fork)	11.4	7.4	15.0	24.1	41.4
13. Bat (lower hand)	26.4	13.2	4.1	12.9	31.5
14. Golf (lower hand)	6.1	2.8	3.0	16.2	40.4
15. Broom (upper hand)	12.4	11.4	23.1	22.1	29.2
16. Rake (upper hand)	10.4	10.4	21.3	22.6	30.2
17. Striking match (holding match)	7.9	4.8	9.6	29.7	46.7
18. Opening box (holding lid)	7.6	8.9	26.6	28.9	27.0
19. Dealing cards (holding cards dealt)	15.0	6.6	4.8	21.1	51.0
20. Threading needle (moving hand)	11.2	5.8	9.6	22.1	50.0
21. Preferred foot in kicking	8.4	4.6	5.3	37.1	42.1
22. Preferred eye looking with one	13.7	17.8	17.8	21.1	25.1

young (18–39 years) males by Lansky et al. (see Table 3). The difference between the four categories in the two studies (see Table 3) is significant ( $\chi^2 = 9.58$ ,  $p < .01$ ).

In the present study, 17.5% used the left hand (only one item from the questionnaire) always for writing, compared to 8.4% of the males presented by Bryden (1977), and 8.0% of the males in the study by Levander and Schalling (1988). The difference between the present study and the other two studies are both statistically significant (difference between percentages,  $z = 4.36$ ,  $p < .001$ ;  $z = 4.34$ ,  $p < .001$ ).

*Twins* The occurrence of twins in the present study was 1.3%, which could be compared to a population twin occurrence of 2.4% (Forsdahl, 1990). This difference

TABLE 3  
Frequencies of handedness (according to Lansky et al., 1988) in the present material, compared to Lansky's et al. (1988) data on white young (18–39 years) males ( $n = 380$ ), and writing with left hand, compared to two other sources

Handedness	Present study ( $n = 394$ )	Lansky et al. (1988) ( $n = 380$ )	Difference
Left	6.9	3.2	$\chi^2 = 9.58^{**}$
Mixed Left	10.6	9.5	
Mixed Right	39.2	31.0	
Right	43.3	56.3	
Left Writing	17.5	8.4 <sup>1</sup>	$z = 4.36^{***}$
		8.0 <sup>2</sup>	$z = 4.34^{***}$

<sup>1</sup>Bryden's (1977) data on males ( $n = 620$ ).

<sup>2</sup>Levander and Schalling's (1988) data on males ( $n = 506$ ).

\*\* $p < .01$  \*\*\* $p < .001$

TABLE 4  
Frequencies of reading difficulties, stuttering, and twinning, compared to other studies.

Variable	Present study ( <i>n</i> = 394)	Pres (ambidext) ( <i>n</i> = 151)	Comparison	Difference
Twins	1.3	2.0	2.4 <sup>1</sup>	<i>z</i> = 1.43 <sup>NS</sup>
Stuttering	7.1	5.3	1.6 <sup>2</sup>	<i>z</i> = 8.70***
Reading difficulties	7.9	11.9	1-3 <sup>3</sup>	<i>z</i> = 8.37***

<sup>1</sup>Forsdahl (1990).

<sup>2</sup>Sheehan (1970).

<sup>3</sup>Hier et al. (1978).

\*\*\**p* < .001

<sup>NS</sup>Non-significant.

was not significant (*z* = 1.43). If only the ambidexter subjects (excluding the consistent Lefts and Rights) were used for the comparison (*n* = 151), the twin occurrence is increased to 2.0%.

*Stuttering* The occurrence of stuttering in the present study was 7.1%, reduced to 5.3% in the ambidexter group. This could be compared to a stuttering incidence of 1.6% in the population (less than 1%, with a sex ratio of 0.20-0.25) (Freeman, 1970). This difference is significant (*z* = 8.70, *p* < .001 for the total, and *z* = 3.62, *p* < .01 for the ambidexter group).

*Reading difficulties* The occurrence of reading difficulties was 7.9% (11.9% in the ambidexter group) as compared to an occurrence of reading difficulties of about 1-3% (Hier et al., 1978), or 1.98% (Beitchman et al., 1986) in the general population. The highest incidence is significantly different from the incidence in our material (*z* = 8.37, *p* < .001 for the total, and *z* = 8.69, *p* < .001 for the ambidexter group).

## DISCUSSION

First, it must be noted that the present study does not include a control group. Instead the results from the experimental group in the present study have been compared to appropriate survey studies (Lansky et al., 1988; Levander and Schalling, 1988; Bryden, 1977). Others (for example Spiegler and Yeni-Komshian, 1983) have reported results on lefthandedness which might have been used as a comparison. However, since that study used college students as subjects it is not suitable as a comparison group. In addition they have used criteria for exclusion which probably skews the results in the direction of more lefthandedness than there actually is in the material they started out with.

The main result of the present study was a clear and significant left shift. The number who exclusively use the left hand in writing was significantly increased. There were also significantly increased occurrences of stuttering and reading difficulties. These results confirmed Geschwind and Galaburda's (1985a, b) hypotheses. However, the twin frequency shows only a tendency towards reduction.

The results in the present study confirm two preliminary studies, which both indicated increased occurrence of lefthandedness (and nonrighthandedness) in homosexual men (Lindesay, 1987 (*n* = 94); McCormick et al., 1990 (*n* = 38)). A third, recent study (Rosenstein and Bigler, 1987 (*n* = 89)) failed to find a correlation

between handedness and sexual preference. A closer comparison to these three studies has not been possible due to differences in the measures used.

The finding that unmarried subjects had a more extreme left shift, might also point in a similar direction (Lansky et al., 1988).

Yalom et al. (1973) studied 20 16-year old boys of diabetic mothers, who had received estrogen or progesterone during the pregnancy. These boys showed less heterosexuality and less masculinity than 20 control boys. Netley and Rovet (1982) showed that among 33 males with 47,XXY syndrome, 24% were nonright-handed, compared to 10% of a control group.

Another area, which has not been taken into account in the present study, is the complicated and great number of psychosocial factors, and social pressures variables, which might contribute to the development of homosexuality, and at the same time influence lefthandedness (Götestam, 1990a, b).

Another interesting fact may confound our results. Geschwind and Galaburda (1985b) have pointed out that lefthanders were more prone to some immunological disorders. Among the study sample, from which our sample is drawn, 29.9% are HIV positive. If it is true that lefthandedness is related to higher susceptibility to HIV infections, this might indirectly have influenced our results (cf. Geschwind and Galaburda 1985b).

In the present study, as well as in Lindsay (1987), only homosexual men were studied. In Rosenstein and Bigler (1987) and McCormick et al. (1990), both men and women were studied, and in the latter study, a significant increase in lefthandedness (or rather nonright-handedness) was obtained for women. This was assumed to be related to higher-than-normal levels of prenatal testosterone levels. In their results, the increase in lefthandedness in homosexual women (which have lower occurrence than men in the general population) is much larger than that of homosexual men. It is, therefore, fair to assume that the increase in testosterone, believed to cause both lefthandedness and homosexuality in women, will give a more pronounced effect in women than in men.

The occurrence of twins in the general population is 2.4% (if born 1941–60: Forsdahl, 1990), and homosexuality in the male population is about 5% (Pillard et al., 1981). From our data on male homosexuals we have 1.3% twins. It is difficult to make extrapolations from our data, but a best guess could be an expectation of a 0.52% homosexual occurrence among twins [ $1.3 \times 2.4/5 = 0.52$ ], which is very low compared to the general population. According to the hypothesis of Geschwind and Galaburda (1985a), the increased lefthandedness in twins is caused by increased prenatal testosterone levels, in the case of twins, *both* from the mother *and* the co-twin. The tendency toward a lower proportion of twins might be explained by the fact that the prenatal testosterone levels do not drop as dramatically for twins as it does for single fetuses, thereby counteracting the low levels of testosterone which could lead to homosexuality. This only accounts for the male twins though. When looking at female twins one would have to consider the same arguments as above, which assumedly will result in more homosexual female twins than male (cp. McCormick et al., 1990).

Kallmann (1952) studied the genetics of homosexuality in 85 male homosexual twins (40 homozygotic and 45 dizygotic). All homozygotic pairs (40) were concordant with regard to homosexuality, while only half (57.7% of 26 index cases) the dizygotic were concordant. This study contradicts the Geschwind and Galaburda (1985b) hypothesis of an intrauterine mechanism, but it has never been replicated. Rather, there are some casuistic studies contradicting Kallmann's (1952) results (Parker, 1964). A more recent study on twins, including their rearing apart (Eckert et al., 1981, 1986) seems to indicate some, but rather complex, genetic influence for

male homosexuality while the genetic influence for female homosexuality is more doubtful. These views are supported in two critical reviews by Meyer-Bahlburg (1979, 1984).

The conclusion from the present study is that there is a left shift in homosexual men, which supports the hypotheses by Geschwind about etiological factors for both lefthandedness and homosexuality.

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