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ORIGINAL PAPER

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Lee Ellis · Christopher Ficek · Donald Burke · Shyamal Das

Received: / Revised: / Accepted:

Abstract The present study sought to expand the limited evidence that sexual orientation is influenced by genetic factors. This was accomplished by seeking statistical differences between heterosexuals and homosexuals for four traits that are known to be genetically determined: eye color, natural hair color, blood type, and the Rhesus factor. Using a sample of over 7,000 U.S. and Canadian college students supplemented with additional homosexual subjects obtained through internet contacts, we found no significant differences between heterosexuals and homosexuals regarding eye color or hair color. In the case of blood type and the Rh factor, however, interesting patterns emerged. Heterosexual males and females exhibited statistically identical frequencies of the A blood type, while gay men exhibited a relatively low incidence and lesbians had a relatively high incidence ($p < .05$). In the case of the Rh factor, unusually high proportions of homosexuals of both sexes were Rh– when compared to heterosexuals ($p < .06$). The findings suggest that a connection may exist between sexual orientation and genes both on chromosome 9 (where blood type is determined) and on chromosome 1 (where the Rh factor is regulated).

Keywords Sexual orientation · Blood type · Rhesus factor · Hair color · Eye color · Genetics

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Introduction

Several lines of evidence have pointed toward biological causes of variations in sexual orientation in recent years (Ellis, 1996; Ellis & Ames, 1987; Rahman, Kumari, & Wilson, 2003), although the specific nature of these causes remain unidentified. In the 1990s, a study tentatively pinpointed a region on the X-chromosome that might be responsible for variations in male sexual orientation (Hamer, Hu, Magnuson, Hu, & Pattattucci, 1993). Since this study was published, two additional studies have appeared bearing on the X-chromosome hypothesis regarding male homosexuality, one supportive (Hu et al., 1995; also see Hamer, 1995) and the other non-supportive (Rice, Anderson, Risch, & Ebers, 1999). In the case of female sexual orientation, no research bearing on genetic etiology has yet been published.

The present study was undertaken to explore genetic influences on sexual orientation by searching for links between sexual orientation and four genetically transmitted traits: eye color, natural hair color, blood type, and the so-called Rhesus factor (i.e., whether one is Rh+ or Rh–). The reasoning behind this approach was as follows: To the degree sexual orientation is genetically influenced, the contributing gene might be located on a chromosome that is involved in determining eye color, hair color, blood type or the Rh factor. If so, one would expect sexual orientation to co-vary with one or more of these four traits.

Method

Participants

The primary data for this study were collected between 1988 through 1998 as part of a wide-ranging investigation of

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sexual orientation among 2,653 male and 5,253 female United States and Canadian college students. The students at 22 universities completed questionnaires as an option for a few points of extra credit in social/behavioral science courses they were taking. The participants ranged from 17 to 63 years of age, with a mean of 22.17 (SD = 5.16). Ethnically, the overwhelming majority (88%) were white, with 5% being black, 3% Native American, and 2% each being Asian/Pacific Islanders and Hispanics.

Measures and Procedure

Measurement of sexual orientation in the main sample involved asking students to indicate if they considered themselves to be heterosexual, homosexual, bisexual, or undecided. In the present analysis, the undecided were excluded, and those answering homosexual or bisexual were combined. Their answers were checked against responses provided by the respondents elsewhere in the questionnaire regarding sexual fantasies about, and attractions to, members of the same and opposite sex. Subjects providing inconsistent responses to these latter questions relative to their self-declared sexual orientation were excluded from the present analysis (see Ellis, Robb, & Burke, 2005).

To measure hair color and eye color, subjects were asked to provide a brief written description in an open-ended format. Each subject's response was consolidated into four categories of hair color: black/dark brown, brown/brunette, auburn/red/strawberry blond; blond/sandy; and three categories of eye color: brown, hazel, blue/gray/green.

In the case of blood type and the Rh factor, our original sample of students was supplemented with subjects from internet contacts because insufficient numbers of homosexuals reported their blood types in our student sample. To be precise, 698 males and 1,386 females provided us with information regarding their blood type and whether they were Rh+ or Rh–. These are large numbers, but they included only small proportions of homosexuals. Even after we collapsed the two rarest blood types (B and AB) into a single cell (yielding three groups: A, B/AB, and O), the student sample provided us with fewer than five subjects in two of the three cells for male homosexuals and in one of the three cells for female homosexuals. Therefore, we invited homosexuals in internet chat lists to provide us with information as to their blood type and Rhesus factor. Data from 12 males and 18 females were obtained in this way, allowing us to meet the minimum sample size of five for each chi square cell (see the bottom portion of Table 1).

Results

Hair Color

The distributions of hair color relative to the sexual orientation and sex of our participants are shown in the upper half of Table 1. Note that the totals for each variable in Table 1 differ because the number of participants providing intelligible answers to each question varied.

Chi square analyses were performed on hair color (1) to determine if significant sex differences existed and (2) to

Table 1 Numbers and proportions of men and women according to hair color and sexual orientation

Variables	Men		Women	
	Heterosexual	Homosexual	Heterosexual	Homosexual
Hair color				
Black/dark brown	16.7% (374)	20.0% (12)	11.1% (496)	3.7% (2)
Brown/brunette	57.4% (1,286)	56.7% (34)	53.8% (2,407)	55.6% (30)
Auburn/red/strawberry blond	3.2% (72)	5.0% (3)	6.0% (269)	3.7% (2)
Blond/sandy	22.7% (508)	18.3% (11)	29.1% (1,302)	37.0% (20)
Eye color				
Blue/grey/green	48.5% (827)	35.4% (17)	49.9% (1,650)	40.5% (17)
Hazel	14.0% (239)	16.7% (8)	16.4% (544)	26.2% (11)
Brown	37.4% (638)	47.9% (23)	33.7% (1,114)	33.3% (14)
Blood type				
A	31.9% (218)	18.5% (5)	33.1% (451)	44.2% (19)
B/AB	21.7% (148)	29.6% (8)	21.8% (297)	14.0% (6)
O	46.4% (317)	51.9% (14)	45.0% (613)	41.9% (18)
Rhesus factor				
Rh+	82.6% (479)	70.8% (17)	80.6% (909)	68.4% (26)
Rh–	17.4% (101)	29.2% (7)	19.4% (219)	31.6% (12)

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look for differences within each sex according to sexual orientation. Significant sex differences were found for hair color (disregarding sexual orientation), with men having significantly greater proportions of darker hair shades than women ($\chi^2 = 124.98$, df = 3, $p < .001$).

No significant differences in hair color were evident according to sexual orientation, either for men ($\chi^2 = 1.22$, df = 3, ns) or for women ($\chi^2 = 3.26$, df = 3, ns). However, three of the cells on hair color contained fewer than five observations. Therefore, we combined "black/dark brown" and "medium brown/brunette" into one category and "auburn/red/strawberry blond" and "blond/sandy" into a second category and recalculated the chi square. This again yielded non-significant differences with respect to sexual orientation both for males ($\chi^2 = 0.20$, df = 1, ns) and for females ($\chi^2 = 0.74$, df = 1, ns).

Eye Color

The possibilities of links between eye color and both sex and sexual orientation are shown in the middle portion of Table 1. Regarding sex differences, men reported having significantly darker colored eyes than did women ($\chi^2 = 12.23$, df = 2, $p = .002$). In the case of sexual orientation, no significant differences between heterosexuals and homosexuals were apparent regarding eye color, either for men ($\chi^2 = 2.22$, df = 2, ns) or for women ($\chi^2 = 1.46$, df = 2, ns).

Blood Type

The bottom half of Table 1 provides information on the ratio of heterosexuals and homosexuals for various blood groups. Even after supplementing our student sample, insufficient number of male and female homosexuals with B and AB blood types forced us to combine these two categories. Both heterosexual samples exhibited virtually identical proportions of all three blood groupings, but this was not the case for gays and lesbians. The greatest differences can be found regarding the A blood type. Whereas 31.9% of males and 33.1% of females had the A blood type, 18.5% of gays and 44.2% of lesbians did. When comparing these four groups, the results were statistically significant ($\chi^2 = 8.91$, df = 3, $p < .03$).

Turning to the Rh factor, another interesting pattern emerged. In this case, there were virtually identical proportions of heterosexual males and females being Rh– (17.4% and 19.4%, respectively). However, in the case of the two homosexual groups, 29.2% of the gays and 31.6% of the lesbians were Rh–. Chi square comparisons of these four groups yielded results that fell slightly short of statistical significance at the .05 level ($\chi^2 = 6.52$, df = 3, $p = .06$). This suggests that homosexuals of both sexes have an elevated probability of being Rh– compared to both male and female heterosexuals.

Discussion

There are several ways to investigate genetic influences on traits, with twin and adoption studies still being the most common. In the present study, a simple but powerful alternative method was employed: Looking for differences in the dependent variable (sexual orientation) in relationship to physical traits that are genetically determined, not just genetically influenced. In other words, for eye color, natural hair color, blood type, and the Rh factor, there appears to be an unerring phenotype-genotype correspondence. Therefore, any statistical relationship that might be found between any of these four traits and sexual orientation could only be explained as reflecting a shared genetic influence. The most likely way any such sharing could occur is if the genes for each statistically associated traits are located on the same chromosome, probably in fairly proximate loci.

No statistical relationships between sexual orientation and either eye color or hair color were found, although there were clear sex differences in these traits with males having darker eyes and hair than females. These sex differences probably reflect tendencies for testosterone to increase pigmentation both in the skin and hair (Relethford, Lees, & Byard, 1985; Tobin, 2006) and in the iris of the eye (Coplan, Coleman, Rubin, 1998). Given this evidence plus that which has implicated testosterone in influencing sexual orientation (see Ellis, 1996), we were surprised to find no statistical links between sexual orientation and either eye color or hair color.

Conversely, in the case of blood type and the Rh factor, no sex differences were found, but differences associated with sexual orientation did emerge. For blood type, A was unusually rare in male homosexuals while it was unusually common among female homosexuals. Regarding the Rh factor, both male and female homosexuals had a high prevalence of Rh– (with statistical significance being just slightly short of the conventional .05 level).

No prior study has investigated the possibility of links between hair color, eye color, blood type, or the Rh factor and sexual orientation. Nevertheless, some studies have reported statistical relationships between blood types and other aspects of human personality. For example, several studies have found unusually high rates of manic depression among persons with the O blood type (Mendlewicz, Massart-Guiot, Wilmotte, & Fleiss, 1974; Parker, Theilie, &

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Spielberger, 1961; Rinieris, Stefanis, Lykouras, & Varsou, 1979; Shapiro, Rafaelsen, Ryder, Svejgaard, & Sorensen, 1977) with one failure to replicate (Masters, 1967). Also, studies have reported unusually high rates of cigarette smoking among persons with both B and AB blood types (Cohen & Thomas, 1962), a propensity for persons with A blood type to score high on a personality measure of "tender-mindedness" (Cattell, Boutourline, Young, & Hundleby, 1964), and high rates of suicide among individuals with O blood type (Voracek, 2004).

Regarding the present study, it is noteworthy that the alleles for blood type are known to be on chromosome 9 (Lewis, Kaita, Giblett, & Anderson, 1978; Saitou & Yamamoto, 1997; Robson, Cook, & Buckton, 1977; Westerveld, Jongsma, Khan, van Someren, & Bootsma, 1976). Likewise, the gene controlling the Rh factor has been located on Chromosome 1 (Cherif-Zahar et al., 1990, 1991). Our findings suggest that genes influencing sexual orientation may reside on both of these chromosomes. In this regard, evidence has emerged in recent years that genes central to sex determination are located on both chromosome 1 (Jordan, Shen, Olaso, Ingraham, & Vilain, 2003) and chromosome 9 (Luo, Ikeda, & Parker, 1994; Ozisik, Achermann, Meeks, Jameson, 2003). In fact, chromosome 9 appears to be carrying remnant genes for the original sex-determining chromosome in several pre-mammalian species (Raymond et al., 1998; Smith, McClive, Western, Reed, & Sinclair, 1999).

Further research is needed to verify our findings. If the results are confirmed, they would point toward genetic susceptibility to variations in sexual orientation. Also, the involvement of blood groups and the Rh factor would implicate the immune system as contributing to homosexuality-heterosexuality. This latter possibility has received some support (Blanchard & Ellis, 2001; Ellis & Hellberg, 2005) but also some criticism (Whitehead, ~~in press~~ 2007).

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ORIGINAL PAPER

Eye Color, Hair Color, Blood Type, and the Rhesus Factor: Exploring Possible Genetic Links to Sexual Orientation

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Abstract The present study sought to expand the limited evidence that sexual orientation is influenced by genetic factors. This was accomplished by seeking statistical differences between heterosexuals and homosexuals for four traits that are known to be genetically determined: eye color, natural hair color, blood type, and the Rhesus factor. Using a sample of over 7,000 U.S. and Canadian college students supplemented with additional homosexual subjects obtained through internet contacts, we found no significant differences between heterosexuals and homosexuals regarding eye color or hair color. In the case of blood type and the Rh factor, however, interesting patterns emerged. Heterosexual males and females exhibited statistically identical frequencies of the A blood type, while gay men exhibited a relatively low incidence and lesbians had a relatively high incidence ($p < .05$). In the case of the Rh factor, unusually high proportions of homosexuals of both sexes were Rh– when compared to heterosexuals ($p < .06$). The findings suggest that a connection may exist between sexual orientation and genes both on chromosome 9 (where blood type is determined) and on chromosome 1 (where the Rh factor is regulated).

Keywords Sexual orientation · Blood type · Rhesus factor · Hair color · Eye color · Genetics

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Introduction

Several lines of evidence have pointed toward biological causes of variations in sexual orientation in recent years (Ellis, 1996; Ellis & Ames, 1987; Rahman, Kumari, & Wilson, 2003), although the specific nature of these causes remain unidentified. In the 1990s, a study tentatively pinpointed a region on the X-chromosome that might be responsible for variations in male sexual orientation (Hamer, Hu, Magnuson, Hu, & Pattattucci, 1993). Since this study was published, two additional studies have appeared bearing on the X-chromosome hypothesis regarding male homosexuality, one supportive (Hu et al., 1995; also see Hamer, 1995) and the other non-supportive (Rice, Anderson, Risch, & Ebers, 1999). In the case of female sexual orientation, no research bearing on genetic etiology has yet been published.

The present study was undertaken to explore genetic influences on sexual orientation by searching for links between sexual orientation and four genetically transmitted traits: eye color, natural hair color, blood type, and the so-called Rhesus factor (i.e., whether one is Rh+ or Rh–). The reasoning behind this approach was as follows: To the degree sexual orientation is genetically influenced, the contributing gene might be located on a chromosome that is involved in determining eye color, hair color, blood type or the Rh factor. If so, one would expect sexual orientation to co-vary with one or more of these four traits.

Method

Participants

The primary data for this study were collected between 1988 through 1998 as part of a wide-ranging investigation of

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