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Relative Lengths of Fingers and Toes in Human Males and Females

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Digital scans of the hands and feet were obtained from 62 heterosexual females and 60 heterosexual males. Scans only of the hands were obtained from 29 homosexual females and 35 homosexual males. The lengths of the individual fingers and toes were estimated from those images by two experienced judges, and length ratios were constructed for all possible pairs of fingers (or toes) on each hand (or foot). Thumbs were not measured, but the great toe was measured and used to construct length ratios. Past research had concentrated on the relative lengths of the index and ring fingers (the 2D:4D ratio). This ratio is close to 1.0 in females and smaller than 1.0 in males. Here 2D:4D did exhibit the largest sex difference, for both hands, followed by 2D:5D and 3D:4D. The sex differences were larger for the right hand than for the left. For both homosexual females and homosexual males, nearly all of the length ratios for fingers were intermediate to those for heterosexual females and heterosexual males; that is, the ratios of homosexual females were masculinized and those of homosexual males were hypomasculinized, but few of these differences were significant. Because many toes were substantially arched, acceptable estimates of length often could not be obtained from the two-dimensional scans, meaning that conclusions about toes are much less certain than those for fingers. Nevertheless, the length ratios were generally larger for toes than for fingers, and the sex differences were generally smaller for toes. © 2002 Elsevier Science (USA)

Key Words: **2D:4D ratio; relative finger length; relative toe length; masculinization; prenatal development; sexual orientation.**

The relative lengths of the index and ring fingers (the 2D:4D ratio) in humans has been a topic of considerable research interest in recent years. To date, the 2D:4D ratio has been shown to exhibit a sex difference (Ecker, 1875; George, 1930; Phelps, 1952; Manning, 2002), to be masculinized in homosexual females (Williams, Pepitone, Christensen, Cooke, Huberman, Breedlove, Breedlove, Jordan, and Breedlove, 2000; Brown, Finn, Cooke, and Breedlove, 2002), to be masculinized in people with congenital adrenal hyperplasia (Brown, Hines, Fane, and Breedlove, 2001b), to be masculinized in children with ADHD (McKay, 2001), to be masculinized in autistic children, to be correlated with adult testosterone level, to be related to onset of breast cancer and heart disease, and so on. These various findings have been summarized by Manning (2002). Sex differences also have been reported for the relative lengths of toes in mice (Brown, Finn, and Breedlove, 2001a; Manning, Callow, and Bundred, 2002) and for both the metacarpals and metatarsals of baboons (McFadden and Bracht, 2002a) and gorillas and chimpanzees (McFadden and Bracht, 2002b). Because the basic human pattern for the hands is laid down early in prenatal development (Garn, Burdi, Babler, and Stinson, 1975; Manning, 2002), and because the sex difference in the 2D:4D ratio exists early in life, the existence of these various differences in the 2D:4D ratio has been interpreted as stemming from differential exposure to androgens during prenatal development (Manning, 2002). The large sex difference in prenatal androgen exposure is well-documented (Smail, Reyes, Winter, and Faiman, 1981). The development of the extremities, and the penis, is under the control of certain homeobox genes (Kondo, Zakany, Innis, and Duboule, 1997), so presumably androgens are acting to modulate the effects of these genes in the two sexes.

Essentially all of the recent work on relative digit length has involved only the 2D:4D ratio for fingers,

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even though numerous other length ratios could be calculated. Further, to our knowledge, there has been no parallel study of the relative lengths of the toes of humans. Here we report the existence of differences by sex and by sexual orientation in several length ratios for the fingers and lesser sex differences for the toes. Elsewhere (McFadden and Shubel, 2002a,b), we report on the relationships between the length ratios determined in this study and the otoacoustic emissions (OAEs) exhibited by these same participants.

METHODS

Participants

Participants unselected for sexual orientation were recruited from introductory psychology courses at the University of Texas. Course credit was given for participation. Signup sheets were posted containing a brief description of the experiment, including the requirement of passing a hearing screening test. There were 150 volunteers. Of these, 23 were excused because of failure to pass the hearing screening test or because of technical difficulties. Two males and two females identified themselves as nonheterosexual, but the responses on related items were inconsistent for most of these subjects, so for simplicity, the data for all of these subjects were discarded. One male having a 2D:4D ratio nearly 4 SD below the mean was excluded as an outlier. The mental-rotation data were excluded from an additional male who appeared inebriated, but the measures of his fingers and toes were retained. The heterosexual results presented here are based on the remaining 60 males and 62 females. The average ages were 19.0 and 19.1 years for those heterosexual males and females, respectively.

Following testing of the psychology undergraduates, homosexual and bisexual participants were recruited using notices sent to homosexual organizations on and off campus, advertisements in specialty publications, and flyers posted at various locations on and off campus. There were 82 respondents. Of these, 17 were excused because of failure to pass the hearing screening test or because of technical difficulties. One male was excluded because of ambiguous responses to questions relating to sexual orientation. The homosexual results presented here are based on the remaining 35 males and 29 females. The average ages were 22.0 and 20.7 for nonheterosexual males and females, respectively. These *N*'s are modest because the primary goal was not to make an extensive comparison of relative digit length in people of differing sexual orientations (for that, see Williams *et al.*, 2000; Robinson and Manning, 2000), but to verify in nonheterosexuals a somewhat surprising outcome obtained in heterosexuals, namely, low correlations between relative finger length and otoacoustic emissions (reported in McFadden and Shubel, 2002a).

All the procedures for recruiting and testing participants were approved by the local institutional review board prior to the initiation of these studies.

Procedure

Prospective participants from the psychology subject pool volunteered for one of an array of available time slots offered on a signup sheet. The sheets indicated that normal hearing would be required, and that participants should not take any drugs or be exposed to intense sounds in the 24 h immediately preceding the test session. Prospective participants responding to the advertising for homosexuals left telephone messages about their interest in the experiment, and were later called back by an experimenter who described the procedures briefly and asked a series of questions that helped establish the volunteer's eligibility for the experiment. Prospective participants were told that they would have to pass a hearing screening test and that they should avoid exposure to drugs and to intense sounds in the 24 h preceding the test session. For both groups of prospective participants, compliance with the restrictions was tested by a hearing screening test and by various items on the questionnaire. Participants recruited from the subject pool received course credit for participating, and nonheterosexual participants were paid $40 each.

All participants were tested for otoacoustic emissions and mental-rotation ability, in addition to having their fingers and toes measured. Here we describe only the latter measurements; the other results are described elsewhere (McFadden and Shubel, 2002b).

Sexual orientation for all participants was determined using several items on the questionnaire. Two were the standard Kinsey items about sexual fantasies and sexual experience. Another was a simple self-description item offering heterosexual, homosexual, and bisexual as the alternatives. Any inconsistencies in the responses to these various items led to the omission of that participant from the data analyses. As noted above, two males and two females were omitted on these grounds. Because the nonheterosexual *N*'s were small, no attempt was made to subdivide the groups into homosexuals and bisexuals.

One questionnaire item asked the participants to choose their ethnicity from the following categories: American Indian or Alaskan Native, Asian, Black or African-American, Native Hawaiian or other Pacific Islander, White, and Other or Unknown (please specify if known).

Hand and Foot Scans

Digital scans were made of all hands and feet using a UMAX Astra 2200 scanner. The images were scanned into Photoshop 5.0 LE (at 300 dpi, Black and White Photo setting) using UMAX VistaScan 3.7.3. Scans were then converted to Canvas 7.0.2, which was the application used to measure the fingers and toes.

For the finger measurements, the subject removed any rings and placed both hands side by side on the glass of the scanner with the fingers together and thumbs approximately parallel to the fingers. A small notecard with the subject's code number was placed on the glass and a white plastic bag filled with styrofoam beads was placed over the hands, covering the entire area of the glass. The subject was told not to press down too hard on the glass, and the scan was taken.

For the feet measurements, the procedure was similar, but imaging the toes was inherently more difficult than imaging the fingers because of the way the toes articulate with the body of the foot. Viewed from below, the ball of the foot obscures the creases at the base of the toes for many people, and those creases are needed to estimate the length of the toes. The solution attempted was as follows: An opaque Plexiglas sheet was attached to the top of a wooden frame such that the sheet fitted closely over the long edge of the scanner and extended to just over its glass bed. The scanner and frame were placed on the floor. The participant was seated before the scanner and was instructed to place the balls of both feet firmly on the edge of the Plexiglas sheet and to push forward until the now-extended toes rested on the scanner bed. Typically, this led to the ball of the foot being pulled back sufficiently to make the creases at the base of the toes better visible than otherwise. Prior to the scan, the participant was given an antiseptic wipe to use for cleaning the feet, and the experimenter cleaned the Plexiglas sheet and the glass bed of the scanner. For hands and feet, the scans obtained were examined immediately, and additional images were acquired when the initial scan was judged not to contain sufficient detail.

All scans were assigned a random four-digit number for the computer file name to conceal any information about the subject from the judges. Even with this precaution, however, the sex of the subject was often obvious. Two or three transparent "layers" were added to the Canvas files, one for each of the judges. Each judge used, and saw, only her transparent layer superimposed on the scanned image when making measurements. (When the file was converted to Canvas, the notecard with the subject's code number was hidden from view.) In the end, each neutrally labeled Canvas file contained a scan of a pair of hands or feet, the subject's code number, and the measurements of all three judges, all on separate layers.

To estimate the length of each finger and toe, each judge used the tools of Canvas to draw a line segment (on her layer) that appeared to her eye to best fit the proximal crease at the base of the digit. The length of this line was approximately equal to the width of the digit. A second line was drawn from the midpoint of the first line to the tip of the digit. A measuring tool in Canvas was used to obtain the length of the second line for all 8 fingers and all 10 toes of each subject. Interjudge correlations were calculated on the lengths of the eight fingers; 81% of the 48 correlations between the three judges were greater than 0.98, with the lowest correlations (still greater than 0.96) being for the length of the smallest finger. The means of the lengths estimated by the three judges were used to calculate ratios of the lengths of all six possible pairs of the four fingers on the same hand, and all 10 possible pairs of the five toes on the same foot for each subject individually. Because the interjudge correlations were so high, only two judges were used for the nonheterosexual participants.

For the first 20 participants, hands were scanned two ways: with the fingers together, as described above, and with the fingers splayed. The interjudge correlations were higher for the nonsplayed condition because it was easier to consistently place the line drawn at the base of the digit.

Many participants had toes that were so arched they could not be laid flat on the scanner bed even when pressure was applied. Thus, any estimate of their lengths from a two-dimensional image would have been an underestimate. The judges were instructed not to estimate the length of any toe they judged to be too arched or for which the ball of the foot obscured the creases at the base of the toe. If any one of the three judges chose not to measure a given toe, it was excluded from all data analyses. This occurred primarily for the shorter toes and for the males. The difficulties associated with obtaining accurate measures of the toes of the heterosexuals led us to omit these measurements when we began testing nonheterosexuals.

Of primary interest for this report were the differences in the length ratios between the sexes and between groups of different sexual orientations. To express and assess those various differences between groups, effect sizes were calculated for the various ratios. Numerically, effect size is the difference between the means of the two groups of interest divided by the square root of the weighted means of the variances for those two groups. For comparisons of the present sort, Cohen (1992) has suggested that effect sizes of 0.2, 0.5, and 0.8 can be interpreted as small, medium, and large, respectively. The outcomes of *t* tests are also presented, but it is important to emphasize that they are provided purely as additional descriptive information about the various comparisons of interest. The number of *t* tests conducted precludes their use for inferential purposes.

RESULTS

Finger Ratios

In terms of average length, the fingers were ordered 3D, 4D, 2D, and 5D from longest to shortest, and this was true for both sexes. On average, heterosexual male fingers were about 0.65 cm longer than the corresponding heterosexual female fingers.

All six possible ratios between the four fingers of each hand were calculated for each subject and then averaged within subject group. Figure 1 shows those average ratios for the four subject groups of interest. As can be seen, every ratio was smaller for heterosexual males than for heterosexual females. This was true for both hands, but this basic sex difference in the ratios was generally greater in the right hand than in the left. Further, for most conditions, the ratios for homosexual females were masculinized (shifted toward the ratios of the heterosexual males), and the ratios for homosexual males were hypomasculinized (shifted toward the ratios of the heterosexual females). Less obvious to the eye is the fact that, for all groups, the ratios tended to be a bit larger for the right hand than for the left.

The ratios shown in Fig. 1 were subjected to a three-factor ANOVA: sexual orientation of subject (4 levels) $\times$ hand (2 levels) $\times$ ratio (6 levels), with repeated measures on the latter two factors. There was a significant main effect for sexual orientation, $F(3,182) = 5.9$, $P = 0.0007$; a significant main effect for hand, $F(1,182) = 21.2$, $P = 0.0001$; and a significant main effect for ratio, $F(5,910) = 5593.5$, $P = 0.0001$. The two-way interaction between orientation and ratio was marginally significant, $F(15,910) = 2.1$, $P = 0.059$, and the two-way interaction between hand and ratio was significant, $F(5,910) = 4.6$, $P = 0.007$. (All but the first of the above probability values are the Greenhouse–Geisser corrected values.) Means comparisons revealed a significant difference between heterosexual females and heterosexual males, $F(1,182) = 16.6$, $P = 0.0001$. The means comparison between heterosexual females and nonheterosexual females was not significant, $F(1,182) = 0.44$, $P = 0.51$. The means comparison between heterosexual males and nonheterosexual males was marginally significant, $F(1,182) = 3.7$, $P = 0.058$.

More informative than the ANOVA are the effect sizes for the various comparisons of interest here. Table 1 contains the effect sizes for the basic sex difference for each of the six possible ratios for each hand. As can be seen, most of the sex differences were medium to large (Cohen, 1992). The ratios showing the largest sex difference were 2D:4D, 2D:5D, and 3D:4D, in that order for both hands. Also, for all three of those ratios, the effect sizes were generally larger for the right hand than for the left. (In this table, all the effect sizes are positive because the average ratio for the females was always larger than that for the males.) When the effect size for a comparison was greater than about 0.4, an unpaired *t* test was calculated for that comparison, and the results of those *t* tests are indicated by the number of asterisks following the effect-size entries. Because a large number of *t* tests were conducted, these statistical results must be viewed only as additional descriptive information. The emphasis should not be on individual statistical outcomes, but on the overall pattern of sex differences, which is remarkably consistent across hands.

Table 2 lists effect sizes for the differences in length ratios between heterosexual and homosexual females and between heterosexual and homosexual males. Generally, the largest of these effect sizes ranged from small to medium (Cohen, 1992). The positive effect sizes for females indicate a masculinization of the homosexual females, and the negative effect sizes for males indicate a hypomasculinization of the homosexual males. Although few of these differences achieved statistical significance, most of the 12 ratios showed the same direction of effect for the females (especially for the right hand), and all 12 of the ratios showed the same direction of effect for the males. Also, there appears to be a trend toward larger effect sizes for

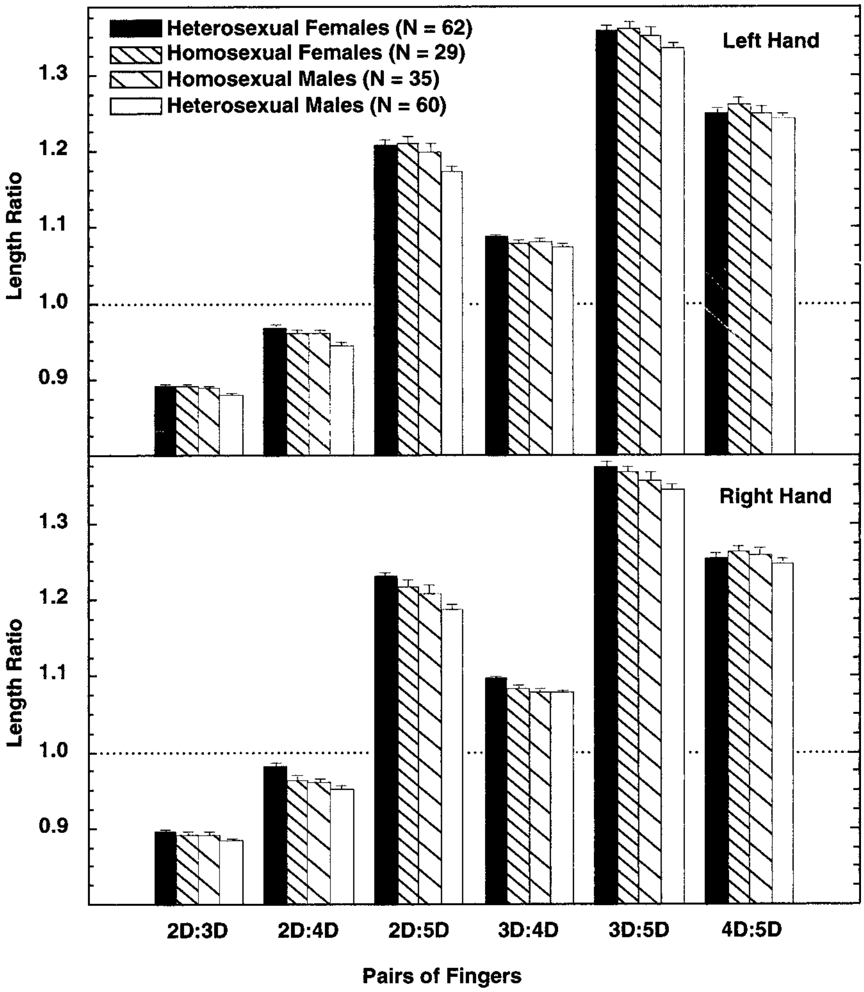

FIG. 1. Average ratios of relative length for various pairs of fingers for heterosexual and homosexual females and males. These ratios were calculated for each subject using the mean of the (two or three) judges' estimates of the length for each individual finger. The error flags designate 1 SEM.

these homosexual–heterosexual differences for the right hand in females and for the left hand in males. The data of Williams *et al.* (2000) contain this same pattern of results in the two sexes. When interpreting the results in Table 2, it is important to keep in mind that the N's for the nonheterosexuals were only about half of those for the heterosexuals.

In an attempt to verify that the results in Table 2 were not attributable to different ethnic representations (see Manning, 2002) in the heterosexual and nonheterosexual groups, the same analyses were conducted with just the participants identifying themselves on the questionnaire as White. The N's fell to 37, 19, 38, and 19 for the heterosexual and nonheterosexual females and the heterosexual and nonheterosexual males, respectively. For the females, the effect

TABLE 1

Effect Sizes for the Basic Sex Difference in Length Ratios for the Two Hands

Ratio	Left-hand effect size	Right-hand effect size
2D:3D	0.49**	0.50**
2D:4D	0.74***	0.85***
2D:5D	0.68***	0.76***
3D:4D	0.54**	0.72***
3D:5D	0.39*	0.51**
4D:5D	0.13	0.13

Note. Entries are the differences between the two means (heterosexual females minus heterosexual males) divided by the square root of the weighted means of the variances of the two samples (Cohen, 1992).

Female $N = 62$; male $N = 60$.

Results from unpaired t tests, two-tailed: *$0.05 > P \geq 0.01$. **$0.01 > P \geq 0.001$. ***$P < 0.001$.

TABLE 2

Effect Sizes for the Differences in Length Ratios for the Two Hands in Heterosexual and Homosexual Females (Top) and in Heterosexual and Homosexual Males (Bottom)

Ratio	Number of Ht/Hm	Left-hand effect size	Right-hand effect size
		Females	
2D:3D	62/29	0.04	0.20
2D:4D	62/29	0.26	0.52*
2D:5D	62/29	−0.02	0.25
3D:4D	62/29	0.35	0.56*
3D:5D	62/29	−0.04	0.15
4D:5D	62/29	−0.26	−0.21
		Males	
2D:3D	60/35	−0.43*	−0.32
2D:4D	60/35	−0.53*	−0.27
2D:5D	60/35	−0.48*	−0.34
3D:4D	60/35	−0.25	−0.04
3D:5D	60/35	−0.25	−0.20
4D:5D	60/35	−0.16	−0.23

Note. Entries are the differences between the two means (heterosexual females minus homosexual females or heterosexual males minus homosexual males) divided by the square root of the weighted means of the variances of the two samples (Cohen, 1992).

Ht, heterosexual; Hm, homosexual.

Results from unpaired t tests, two-tailed: *$0.05 > P \geq 0.01$. **$0.01 > P \geq 0.001$. ***$P < 0.001$.

sizes were substantially the same. For the males, all but one of the 12 effect sizes was larger (many substantially so, and more so for the left hand than for the right), and all the signs remained the same (indicating hypomasculinization, just as when all participants were included).

One might wonder how the various differences in ratios in Tables 1 and 2 came about. Was one finger of a pair "too long" or another "too short"? We know of no way to answer this question when the comparison is between males and females because the absolute differences in length eliminate any benchmark against which to make a comparison. However, it does not seem inappropriate to use heterosexuals as a benchmark for comparisons with nonheterosexuals of the same sex. Accordingly, we note that, for the right hand, the lengths of digit 4 were more similar in heterosexual and nonheterosexual females, and also in heterosexual and nonheterosexual males, than were the lengths of digit 2. That is, the differences seen in the length ratios were largely attributable to digit 2. For the left hand this was again true for the females, but for the males, it was digit 4 that produced the (small) difference in the length ratio.

Toe Ratios

As noted, it was impossible to obtain acceptable measures of the lengths of many toes from our two-dimensional scans, especially from the shorter toes and especially from the males. Accordingly, the *N*'s were small for many of the 10 possible length ratios that theoretically could be calculated for each foot, and the reader is cautioned to keep this problem in mind when examining the data for the toes. By the time the testing of nonheterosexuals began, we knew that toes were not providing much information, so we dropped the scanning of feet from the experimental protocol for those participants.

In terms of average length, the toes were ordered 1D, 2D, 3D, 4D, and 5D from longest to shortest, and this was true for both sexes. On average, heterosexual male toes were about 0.34 cm longer than the corresponding heterosexual female toes.

For each foot of each subject, as many of the 10 theoretically possible length ratios were calculated as the data allowed. Those individual ratios were averaged to produce the results shown in Fig. 2. As can be seen, for ratios not involving the great toe, the length ratios were typically smaller for females than for males (opposite from the direction of effect seen for the fingers), and this was true for both feet. For ratios involving the great toe, however, the average ratio was sometimes larger for females than for males.

The small, and markedly unequal, *N*'s across ratios made statistical tests of these data problematic, but for consistency with the finger data, effect sizes for the basic sex difference are listed in Table 3. Clearly, most of these effect sizes were smaller than those for fingers (Table 1). Furthermore, most of them were negative, unlike the values seen in Table 1. This reversal of sign is attributable to the generally smaller ratios obtained for females than for males (see Fig. 2). The tendency toward larger sex differences on the right side of the body was not as evident in these toe data as it was in the finger data, but again, considerable caution is necessary because the *N*'s were quite small for some of the ratios.

Correlations were done between the corresponding ratios for the hands and feet on the same side of the body. Perhaps not surprisingly, given the different patterns of lengths of the fingers and toes, the correlations were generally small—79% of the correlations were smaller than 0.35. The largest correlations were about 0.48 and 0.42 for 2D:4D on the right and left sides of the body, respectively, in the females.

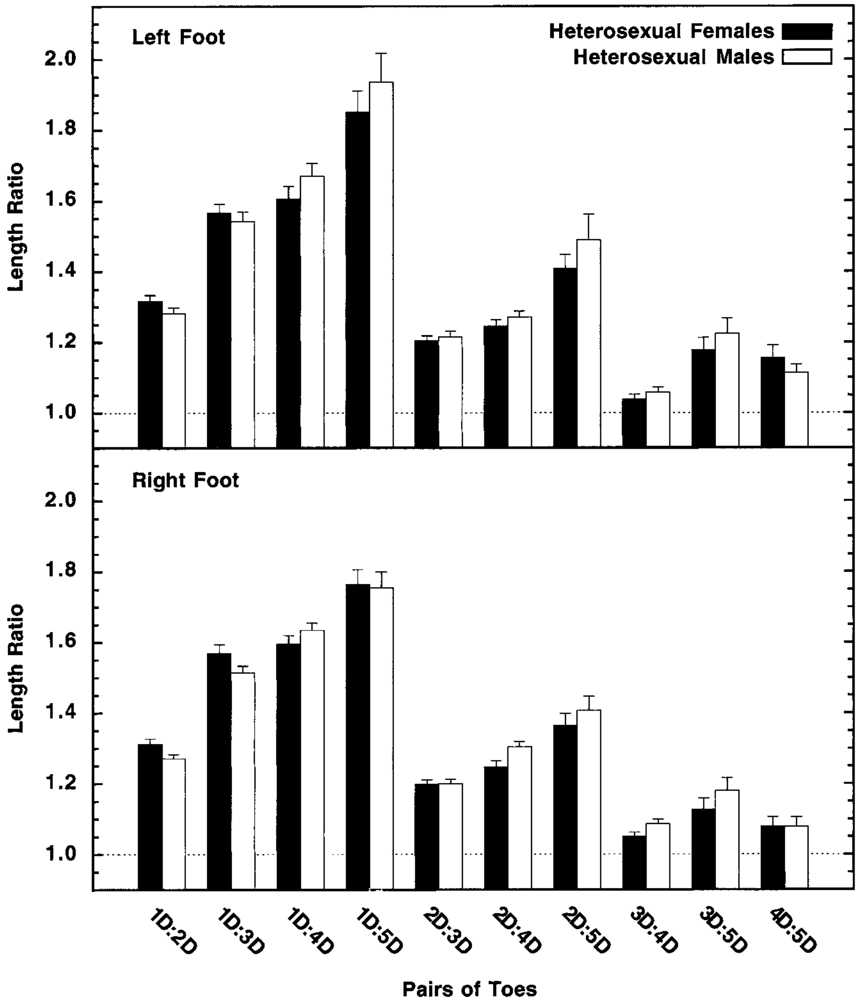

FIG. 2. Average ratios of relative length for various pairs of toes for the heterosexual females and males only. These ratios were calculated for each subject using the mean of the three judges' estimates of the length for each individual toe. The error flags designate 1 SEM. The number of participants contributing to each measure varied greatly; the *N*'s are listed in Table 3.

DISCUSSION

To our knowledge, this is the first modern report on length ratios for pairs of human fingers other than 2D:4D (compare George, 1930; Phelps, 1952; and see final paragraph of this section), and the first attempt to obtain parallel data for human toes. Sizable sex differences were observed for many of the length ratios calculated for both the fingers and the toes. In general, the effect sizes for sex difference were larger for hands than feet, and larger for the right hand than for the left hand (also observed by Willams *et al.*, 2000 and Brown *et al.*, 2002). For fingers, the ratio exhibiting the largest sex difference was 2D:4D, but several other ratios were close contenders. Thus, it seems fair to conclude that 2D:4D is not unique among the various possible length ratios for the fingers; it is only quantitatively, not qualitatively, different from those other length ratios. Obtaining acceptable estimates of length was much more difficult for toes than for fingers, but it seems safe to conclude that the sex differences in relative toe length are smaller than those for finger length, and the lateral asymmetries in length ratios are more complex than for fingers.

For nonheterosexual females, several of the length ratios for fingers were shifted in the male direction, which replicates the masculinization effect reported by Williams *et al.* (2000). The shifts were greater for the right hand than for the left (see Table 2), which is in accord with the Williams *et al.* (2000) report of a

TABLE 3
Effect Sizes for the Basic Sex Difference in Length Ratios for the Two Feet

	Left foot		Right foot	
Ratio	Number of F/M	Effect size	Number of F/M	E ffect size
1D:2D	50/45	0.31	56/46	0.39*
1D:3D	44/29	0.15	53/40	0.36
1D:4D	23/13	−0.42	33/30	−0.30
1D:5D	14/7	−0.38	20/15	0.05
2D:3D	41/28	−0.12	51/37	−0.03
2D:4D	21/12	−0.35	32/28	−0.60*
2D:5D	14/7	−0.49	20/14	−0.28
3D:4D	21/12	−0.34	30/27	−0.54*
3D:5D	14/6	−0.38	19/15	−0.39
4D:5D	12/5	0.38	18/14	0.00

Note. Entries are the differences between the two means (heterosexual females minus heterosexual males) divided by the square root of the weighted means of the variances of the two samples (Cohen, 1992).

F, female; M, male.

Results from unpaired t tests, two-tailed: $^*0.05 > P \geq 0.01$. $^{**}0.01 > P \geq 0.001$. $^{***}P < 0.001$.

greater difference between heterosexual and nonheterosexual females for the right hand, and with the Brown *et al.* (2002) report of a larger difference between self-identified butch and femme lesbians for the right hand than for the left.

For nonheterosexual males, several of the length ratios for fingers were shifted in the female direction (hypomasculinized), and the effect appeared to be stronger for the left hand than for the right (Fig. 1, Table 2). R. Lippa (personal communication, 25 March 2002) also observed hypomasculinization of 2D:4D in the homosexual males he studied, and Williams *et al.* (2000) observed (nonsignificant) hypomasculinization of the 2D:4D ratio for nonheterosexual males, but only for the left hand (their Fig. 1a). These hypomasculinizations run contrary to the hypermasculinizations of 2D:4D reported by Robinson and Manning (2000) and Rahman and Wilson (2002) and to the hypermasculinization observed by Williams *et al.* (2000) for nonheterosexual males with more than one older brother (their Fig. 1b). Such discrepancies across studies are troubling, and there is a strong temptation to believe that the ethnic makeup of the samples in the different studies may be at the heart of the discrepancies. Manning (2002, his Figure 1.7) has shown that the magnitude of the 2D:4D ratio can vary widely across ethnic groups even though the difference between the sexes remains about the same within groups. Thus, the difference between groups of heterosexual and nonheterosexual males could be positive, negative, or zero depending on the ethnic makeup of the two groups. The problem with this explanation is that Robinson and Manning (2000) were clearly alert to this possibility and took steps to ensure homogeneity of ethnic background in their heterosexual and nonheterosexual samples. Lippa also was aware of this possible confound, and analyzed his data accordingly. Further, when we analyzed the present data according to ethnic background, the same basic pattern of hypomasculinizations seen in Table 2 remained. Besides, any appeal to possible inadvertent differences in ethnic mix to explain the discrepancies in the findings for nonheterosexual males seemingly must also explain why different studies have been uniform in finding a masculinization for nonheterosexual females. Another possible explanation for the discrepancies between studies is that the different samples were heterogeneous with respect to the number of nonheterosexual males included who had several older brothers.

At this time, we have no satisfactory explanation for the discrepancies across studies in the findings about relative finger length in nonheterosexual males. We note, however, that nonheterosexual males have previously been reported to be hypomasculinized for throwing accuracy and hand strength (Hall and Kimura, 1995) and hypermasculinized for penis length (Bogaert and Hershberger, 1999) and certain auditory evoked potentials (McFadden and Champlin, 2000). A proposal called “localized effects” has been advanced to account for the existence of group differences in opposite directions for different traits or characteristics in the same special population (McFadden, 2002). Basically, the suggestion is that the masculinization of various traits and characteristics should be thought of as the result of mechanisms that operate locally in space and time rather than globally and simultaneously on the entire body or brain. We wish to reiterate that the sample sizes here for nonheterosexuals were small, and even the largest effect sizes between heterosexuals and nonheterosexuals (Table 2) were medium in magnitude.

Measurements of the metacarpals and metatarsals of baboon skeletons (McFadden and Bracht, 2002a) and gorilla and chimpanzee skeletons (McFadden and Bracht, 2002b) reveal a number of parallels with the data from humans. Many of the length ratios exhibit sex differences that range from medium to large in magnitude, and those sex differences are typically larger in one hand and one foot than in the other. Also, Brown *et al.* (2001a) and Manning *et al.* (2002) have reported sex differences in the relative lengths of the hind toes in mice that are larger in one paw than the other. Apparently, whatever mechanisms are operating to produce sex differences in the bones of the extremities of humans have their counterparts in other mammals. Manning (2002) has suggested that the existence of the sex difference in the 2D:4D ratio is attributable to differential exposure to androgens during prenatal development. Under this explanation, the existence of similarities and differences across species in the patterns of the sex differences for length ratios suggests some continuity and some divergence in the functioning of those underlying mechanisms across evolutionary time. It is interesting to speculate whether the pattern of sex differences in digit length ratios might ultimately prove valuable for cladistic analysis.

Following the submission of this article for publication, we became aware of the report of Manning *et al.* (2002), who also measured all six length ratios for the fingers of humans. Those data confirm the finding here that ratios other than 2D:4D show sex differences, but the patterns of the results were not identical to those here. For example, the effect sizes for the sex difference were substantially smaller than those here, and the sex difference was not largest for the 2D:4D ratio, but for 2D:5D. The Manning *et al.* (2002) article is a brief review, and the lack of procedural details makes speculation about these curious outcomes difficult.

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