

## Box 6-1: Through a Glass, Darwinian

*Digit Length and the Masculinized Brain (Fingers as Windows to the Masculinized Brain)*

In vertebrates the differentiation of both the urinogenital system and the appendicular skeleton is controlled by Homeobox (Hox) genes (Manning, Scutt, Wilson, & Lewis, 1998). The common control of digit and gonad differentiation is reflected in the relationship between relative digit length and indicators of prenatal masculinization. The differentiation of the testes during the 8<sup>th</sup> week following conception results in an increase in fetal testosterone that effects both digit formation and the differentiation of the central nervous system. The ratio of the 2<sup>nd</sup> digit (index finger or 2D) and the 4<sup>th</sup> digit (ring finger or 4D) shows a pattern of sexual dimorphism. Manning et al. (1998) found a mean 2D: 4D ratio of 0.98 for males and 1.00 for females. In other words, in men the fourth digit tended to be longer than the second but in women the two digits tended to be identical in length. This dimorphic pattern is present in young children and is probably established before birth. Testosterone levels and sperm production in men is negatively correlated with 2D:4D ratios. Thus, a longer 4<sup>th</sup> digit in relation to the 2<sup>nd</sup> digit is associated with higher testosterone levels and greater spermatogenesis. These findings suggest that 2D:4D ratio may be a marker for prenatal testosterone levels.

Consequently, many behavioral tendencies associated with highly masculinized brains should correlate with 2D:4D ratios and relative digit length. Exposure to high concentrations of testosterone in utero may have the effect of slowing left hemisphere growth while accelerating growth in certain right hemisphere areas. Such a pattern of neural development might be manifested in impaired verbal abilities but enhanced spatial, mathematical and musical abilities. High testosterone levels have also been associated with immunosuppression and vulnerability to depression. Martin, Manning and Dowrick, (1999) found a significant correlations between digit length divided by height and depression for all five digits in 52 male participants. The strongest correlation was with the 4<sup>th</sup> digit. In 50 women participants no correlations were found with any digits divided by height and depression.

Sluming and Manning (2000) found that 54 male musicians had significantly lower 2D:4D ratios than 86 controls. Furthermore, among the musicians, 2D:4D ratios predicted rank with low 2D:4D ratios being associated with high rank. This may reflect either differences in musical talent or differences resulting from testosterone mediated competitiveness. Differences in 2D:4D ratio were not found among instrument groups, suggesting that 2D:4D was not related to mechanical advantages in playing particular instruments. Concert audiences showed evidence of a

female-biased sex ratio in seats close to the orchestra. Sluming and Manning contend that this data supports the thesis that music is a sexually selected trait in men that provides honest signal of fertilizing capacity and perhaps good genes. Musical ability is an honest signal because high prenatal levels of testosterone are associated with a number of deleterious effects such as immosuppression, dyslexia and stammering. The presence of musical ability without these negative aspects indicates male virility and good genes. In males who had high prenatal testosterone levels but did not become musicians their fertility might be advertised in other ways, athletic prowess, for example.