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Fingerprint asymmetry predicts within sex differences in the performance of sexually dimorphic tasks

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Abstract

Finger ridge counts (FRC) based on the dermal ridges of the human fingerprint are known to be asymmetrical with the majority of individuals having more ridges on the right hand (R>) while a minority have more on the left (L>). Using 48 adult participants, we investigated the association between sex, FRC asymmetry and performance on a battery of six cognitive tasks (two female-favouring, two male-favouring and two sex-neutral). Sex differences in task performance were in the predicted direction although the size of the difference was task dependent. The major finding was an association between FRC asymmetry and task performance. Irrespective of sex, female-favouring tasks were performed better by L> individuals, male-favouring tasks were performed better by R> individuals, while sex-neutral tasks showed no group differences. These FRC-related differences in cognitive performance, that are present within each sex, could contribute to the elusive nature of sex differences in cognitive abilities. In addition, given that finger ridge development is complete by the 16th foetal week, the relationship between FRC asymmetry and pattern of cognitive performance that we have found is consistent with the view that prenatal biological factors, possibly gonadal steroids, exert an organizing influence on neuropsychological development.

Keywords: Dermal ridge asymmetry; Human fingerprints; Cognative tasks; Sex differences; Gonadal hormones

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1. Introduction

In an influential review, Maccoby and Jacklin (1974) concluded that, on average, men tend to excel at spatial and certain mathematical tasks whereas women excel at verbal and fine motor tasks. Subsequently, the existence of sex differences in cognitive abilities has generated controversy. Some authors have emphasised the large number of null findings and denied the existence of sex differences in cognitive performance (e.g. Caplan, MacPherson & Tobin, 1985; Hyde & Linn, 1988) while others have reached the opposite conclusion on the basis of the same data (Halpern, 1992). Null findings arise for two reasons. First, tasks differ in the extent to which they reveal sex differences, ranging from strongly female-favouring through sex-neutral to strongly male-favouring. Second, the data show marked individual differences giving rise to a large within sex range and an extensive overlap between the sexes such that some women show a male-typical and some men a female-typical pattern of performance. In this paper we address both of these issues and also the perennial question concerning the influence of biological, as opposed to socio-cultural factors, on sex differences in cognitive performance.

A major biological difference between the sexes is the level of testosterone to which individuals are exposed early in life. There is a wealth of evidence that perinatal exposure to testosterone exerts powerful organizational effects on brain and behaviour in animals (see Breedlove, 1992; Nelson, 2000) and an increasing number of studies have revealed evidence for similar prenatal organizational effects in humans (Collaer & Hines, 1995). Biological sex divides individuals into two groups typically exposed to different prenatal levels of testosterone: high in men and low in women. If prenatal testosterone exposure does influence the pattern of cognitive performance we might expect clear differences in cognitive performance. However, as we have seen, one of the characteristics of male and female performance on sexually dimorphic tasks is the existence of a large within sex range and a marked overlap between the sexes. Some of this variance may arise from the adult activational effects of gonadal steroids on performance (Hampson & Kimura, 1992; Sanders & Wenmoth, 1998a, b; Van Goozen, Cohen-Kettenis, Gooren, Frijda & Van de Poll, 1994, 1995). However, individual differences in performance may also result from differential prenatal exposure to the organizing effects of hormones and/or other biological events. Insofar as the variance in performance arises from biological rather than sociocultural influences, biological sex may be no more than a crude marker for effective differential exposure. There may be biological characteristics other than sex that are better markers for the critical prenatal organizing events operating within, as well as between, the sexes to give rise to individual differences in the performance of sexually dimorphic tasks.

Levy (1969, 1971) suggested that sex differences in cognitive abilities might be explained by sex differences in functional cerebral asymmetry such that right hemisphere development and performance underlie the superior performance of spatial tasks as seen in men. Subsequently, Levy and Levy (1978) suggested that sex hormones might affect the development of body asymmetries, including brain asymmetries. Animal studies have provided some support for this view. Sex-related neuroanatomical asymmetries have been reported for rats where the right hemisphere is thicker than the left in males but not in females (Diamond, Dowling & Johnson, 1981). These asymmetries appear to be modified by neonatal gonadectomy (Diamond, 1984) suggesting that they are one of many characteristics that are influenced by the organizational effects of perinatal sex hormones.