Letters to the editor

‘Second to fourth digit ratio and dyslexia: no evidence for an association between reading disabilities and the 2D:4D ratio’

SIR—There is accumulating evidence that the ratio of the length of the index (2D) to the ring finger (4D) is a marker of fetal testosterone exposure.1,2 This 2D:4D ratio is assumed to be sexually dimorphic, with mean values being lower in males than in females. Recently, the digit ratio has been used to examine claimed relationships between prenatal testosterone levels and, among other things, autism, left-hand preference, psychopathology, and congenital adrenal hyperplasia.

Elevated prenatal testosterone levels are also reportedly associated with dyslexia.3 Developmental dyslexia refers to a psychopathology, and congenital adrenal hyperplasia.

However, as no significant differences in digit ratio between males and females was found either, this implies that the present study is inconclusive regarding the testosterone account of dyslexia. In contrast, the main conclusion is that this study provides no support for the assumed relation between the 2D:4D ratio and prenatal testosterone, because, in that case, a difference between the sexes should have been found. Given the high statistical power, the results of the present study cast doubt on the idea that the 2D:4D ratio is a valid marker of prenatal testosterone.

At first glance, the results of the present study appear to be in clear conflict with the results of others, who did report sex differences in digit ratio. A closer examination of the pertinent literature, however, shows that in several other studies a difference in digit ratio between the two sexes was not found or not mentioned at all.1,2,7,8 We would also like to point out that the relative digit length is set before the 14th week of gestation. Cerebral development, however, takes place at a later embryonic stage than skeletal formation. In the case of dyslexia, alterations in the cortical neural architecture are generally associated with disruptions occurring towards the end of the second trimester of fetal development. However, a proper model explaining how a single testosterone-related mechanism accounts for both of these prenatal developments is lacking.

Thus, although the digit ratio as an indicator of fetal testosterone seems to be an interesting concept, both empirical inconsistencies and a lack of a solid theoretical foundation suggest that the validity of the 2D:4D ratio requires further elaboration before it may be used to make strong conclusions about the role of fetal testosterone levels in the aetiology of neurodevelopmental disorders, such as dyslexia.

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References
Van Gelder and colleagues report that mean 2D:4D ratio does not differ in children with and without dyslexia, and between males and females. They conclude that their data ‘provides no support for the assumed relationship between 2D:4D ratio and prenatal testosterone’. This is the first published comparison of 2D:4D in children with dyslexia and children without dyslexia. As such it is to be welcomed. However, I do have concerns regarding their finding that 2D:4D is not sexually dimorphic, and, in turn, these concerns cast some doubt on the methodology of this study.

It has been known for some 100 years that the relative lengths of the 2nd and 4th fingers show sexual dimorphism. Initially, 2D:4D finger ratios were measured in terms of the distal extent of the fingers, but more recently ratios of actual finger length have been used.\(^1,2\) Mean 2D:4D tends to be lower in males compared with females and this sex difference has a medium to small effect size.\(^3\) In adults, comparisons of mean 2D:4D across ethnic groups have shown significant sex and ethnicity differences.\(^3,5,4\) In children, similar effects can be seen in a recent study of 798 participants which consisted of Caucasian (Berber, North Africa, \(n=90\); Uygur, North West China, \(n=438\)), Oriental (Han, China, \(n=118\)), and Black (Afro-Caribbean, Jamaica, \(n=152\)) participants.\(^5\) Males had lower mean 2D:4D than females in all four samples and the difference was significant in three (Uygur, Han and Jamaican). There was also an ethnicity effect with highest mean 2D:4D in the Oriental Han followed by the Caucasian Berbers and Uygurs, and the lowest mean 2D:4D was noted in the Afro-Caribbean Jamaican children. A two-factor analysis of variance showed that the sex and ethnicity differences were independent of one another, with no significant interactions. This suggests that the non-significant sex difference found in the Berber sample was the result of sampling effects (this was the smallest sample of the four). It also indicates that studies of 2D:4D should be carefully controlled for ethnicity. The sample of van Gelder et al. is quite large but their letter does not mention controls for ethnicity. The failure to find sex differences in 2D:4D may result from ethnicity effects from a heterogeneous sample. If this is so, the conclusion that those with dyslexia and those without dyslexia do not differ in their mean 2D:4D may be incorrect.

In children, low 2D:4D has been found to be associated with left-hand preference, autism, Asperger syndrome, hyperactivity, poor social cognitive function, and low scores for neuroticism.\(^6-9\) These associations are consistent with a link between low 2D:4D and high prenatal testosterone. Further work is necessary before we can be sure whether mean 2D:4D does or does not differ between children with dyslexia and children without dyslexia.

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