

Research in Brief:

Digit ratio (2D:4D) and beliefs in superstitions, conspiracy theories and the paranormal

Dr Gareth Richards

The 2D:4D ratio is calculated by dividing the length of the second finger by that of the fourth, and is sometimes employed as a proxy indication of prenatal sex hormone exposure. The current study investigated associations between 2D:4D and beliefs in superstitions, conspiracies, and the paranormal, in a sample of 211 university students. Although no significant relationships emerged, positive correlations between 2D:4D and paranormal and superstitious beliefs have previously been reported in the literature, implying that high levels of prenatal oestrogen and/or low levels of prenatal testosterone may be implicated in their development..

Introduction

THE RELATIVE LENGTHS of the second and fourth fingers (2D:4D) have been proposed to indicate prenatal sex hormone exposure (Manning, Scutt, Wilson, & Lewis-Jones, 1998). The ratio is sexually dimorphic (males typically display relatively longer ring fingers; Manning et al., 1998), and might be explainable by finger and genital development both being controlled by HoxA and HoxD genes (Dickman, 1997). Evidence for the efficacy of digit ratio as a proxy indication of the prenatal environment comes from Lutchmaya et al. (2004), who reported that the ratio of testosterone to estradiol observed through amniocentesis was associated with subsequent 2D:4D. More recently, Zheng and Cohn (2011) demonstrated that directly manipulating testosterone and oestrogen levels during gestation could alter the digit ratios of mice in a predictable manner.

The 2D:4D ratio has been shown to correlate with a considerable number of variables, ranging from athletic performance to musical ability and susceptibility to disease (see Manning, 2008 for an overview). Although discrepancies are common within the literature, Austin, Manning, McInroy,

and Mathews (2002) identified a tendency by which within-sex correlations between 2D:4D and 'male typical traits' (i.e. those in which males usually exceed females in scores, propensity, and risk) are negative in males, and less pronounced or absent in females, whereas the opposite pattern is common for female typical traits.

Of interest is that 2D:4D is related to certain aspects of personality. For instance, when investigating associations with the Big Five, Lippa (2006) found that 2D:4D correlated positively with extraversion, and negatively with openness to experience. Voracek (2009) observed that 2D:4D in males was positively associated with beliefs in superstitions and the paranormal, and suggested that the findings may relate to schizotypy. Though Voracek's results are contrary to the previously discussed observation of Austin et al. (2002), a replication study by Rogers, Caswell, and Brewer (2017) reported positive associations between 2D:4D and certain types of paranormal belief in females, but not in males. The findings from these studies are relevant in light of a theory put forward by Crespi and Badcock (2008). Their idea is that autism spectrum and psychotic spectrum

disorders exhibit diametrically opposing phenotypes, which are potentially explainable, at least in part, by the action of prenatal sex hormones. Evidence for this comes from the finding that those diagnosed with Asperger's syndrome exhibit lower 2D:4D than controls, but higher 2D:4D than those diagnosed with autism (Manning et al., 2001). Further to this, Voracek (2008) reported that the literature, although not without inconsistencies and replications failures, generally suggests autism spectrum disorders to be related to low 2D:4D, and schizophrenic spectrum disorders to be related to high 2D:4D.

Based on the available evidence, the current study proceeded with the idea that high 2D:4D is related to personality characteristics associated with schizotypy. More specifically, the study aimed to replicate the findings of Voracek (2009) by examining 2D:4D in relation to paranormal and superstitious beliefs. In addition, conspiracy beliefs were also investigated, both due to their theoretical similarity and because of their associations with schizotypy. It was therefore hypothesised that any significant correlations would be in the positive direction.

Method

Participants

Two hundred and eleven (106 male, 105 female) university students with an age range of 18–35 ($M = 20.73$, $SD = 2.16$) were enrolled in the current study via opportunity sampling. The research was granted ethical approval by Swansea University's Department of Psychology Ethics Committee, and all procedures were conducted in accordance with their guidelines.

Apparatus/Materials

The Revised Paranormal Belief Scale (Tobacyk, 2004) was utilised to assess participants' beliefs in paranormal phenomena. The 26-item measure contains subscales relating to seven dimensions of paranormal belief (traditional religious belief, psi, witchcraft, superstition, spiritualism, extraordinary

life forms, and precognition), and participants marked how strongly they endorsed each statement on a seven-point scale (1 = Strongly disagree, 7 = Strongly agree). However, the individual subscales were not investigated in the current study; instead, an overall indication of paranormal belief was calculated by summing the responses for all items included in the questionnaire.

Positive and Negative Superstitious Beliefs Questionnaire was administered to investigate beliefs in positive and negative superstitions. This measure was used because, although positive and negative superstitious beliefs appear to serve different psychological functions (Wiseman & Watt, 2004), the Revised Paranormal Belief Scale only includes questions to assess the latter type. Three items relating to positive superstitions and three items relating to negative superstitions were marked on a five-point scale (1 = Definitely Yes, 5 = Definitely No). In addition, a measure of total superstitious belief was calculated from the sum of these two scales.

The Belief in Conspiracy Theories Inventory (Swami, Chamorro-Premuzic, & Furnham, 2010) includes 14 items and was used to measure beliefs in well-known conspiracy theories. Participants rated how strongly they agreed with each statement on a nine-point scale (1 = False, 9 = True).

The Generic Conspiracist Beliefs Scale (Brotherton, French, & Pickering, 2013) includes 15 items and was used to evaluate general susceptibility to belief in conspiracy theories. Participants rated how likely they believed each statement to be true on a five-point scale (1 = Definitely not true, 5 = Definitely true).

Design & Procedure

Participants were presented with an information sheet, and provided informed consent prior to taking part in the study. Pen and paper questionnaires were then administered, and the second and fourth digits on

each hand were measured directly using Vernier callipers (measuring to 0.1mm). All finger measurements were taken twice, to increase accuracy. Mean values for digit ratio on the right hand (R2D:4D) and left hand (L2D:4D) were calculated from the two sets of measurements, which were then used in subsequent analyses. As the difference between these values is sometimes used as an additional measure of prenatal androgen action, directional asymmetry was then calculated as $D_{(R-L)}$.

The current study utilised a correlational design. Due to the sexually dimorphic nature of the 2D:4D ratio, separate analyses were conducted for males and females. Sex differences were assessed using between-subjects *t*-tests, and associations between 2D:4D and the questionnaire measures were investigated using Pearson's correlations.

Results

R2D:4D was lower in males ($M = .97$, $SD = .033$) than in females ($M = .98$, $SD = .032$), $t(206) = -2.084$, $p = .038$, although a similar effect in L2D:4D was only marginally significant (males $M = .975$, $SD = .33$; females $M = .983$, $SD = .031$), $t(207) = -1.869$, $p = .063$. No

sex difference was detected for $D_{(R-L)}$, $t(205) = -.886$, $p = .377$.

Considerable variance was observed in response to the questionnaire measures of paranormal, superstitious, and conspiracy beliefs (for descriptive statistics, see Table 1). Significant sex differences were detected for each measure of paranormal and superstitious belief, with females reporting higher scores than males in each case. However, no such effects were observed for either questionnaire measure of conspiracy beliefs (for all *t* and *p* values, see Table 1).

Pearson's correlations were conducted to determine whether associations existed between digit ratio and the questionnaire measures of belief in the paranormal, superstitions, and conspiracy theories. No statistically significant relationships were observed (for *r* and *p* values, see Table 2).

Discussion

Voracek (2009) found that 2D:4D was positively associated with paranormal and superstitious beliefs in Austrian males, and Rogers et al. (2017) reported positive correlations between 2D:4D and paranormal beliefs in female undergraduate students from the UK.

Table 1. Descriptive statistics and sex differences for questionnaire measures of belief in the paranormal, superstitions, and conspiracy theories.

	Males			Females			Sex difference	
	<i>N</i>	<i>M</i>	<i>SD</i>	<i>N</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>
Revised paranormal belief scale	104	55.09	22.25	102	63.77	22.32	2.798	.006
Positive superstitious belief	106	9.61	3.44	104	11.61	2.92	4.529	< .001
Negative superstitious belief	105	6.55	3.74	105	8.71	3.8	4.156	< .001
Total superstitious belief	105	16.13	6.16	104	20.29	5.84	5.004	< .001
Belief in conspiracy theories inventory	99	47.72	19.98	101	47.7	19.14	.005	.996
Generic conspiracist beliefs scale	103	35.72	10.85	104	37.96	10.63	1.503	.134

Table 2. Correlations between 2D:4D variables and questionnaire measures of belief in the paranormal, superstitions, and conspiracy theories.

	Males		Females	
	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>
Revised paranormal belief scale				
R2D:4D	-.023	.821	.008	.934
L2D:4D	-.07	.482	.009	.925
D _(R-L)	.059	.558	.006	.954
Positive superstitious belief				
R2D:4D	-.155	.114	.172	.084
L2D:4D	-.07	.482	.069	.488
D _(R-L)	-.118	.234	.126	.206
Negative superstitious belief				
R2D:4D	-.118	.231	.055	.583
L2D:4D	-.119	.231	-.066	.505
D _(R-L)	.017	.862	.142	.152
Total superstitious belief				
R2D:4D	-.16	.106	.125	.212
L2D:4D	-.114	.251	-.005	.963
D _(R-L)	-.053	.597	.155	.121
Belief in conspiracy theories inventory				
R2D:4D	.061	.55	.025	.81
L2D:4D	-.012	.911	.036	.719
D _(R-L)	.112	.277	-.041	.685
Generic conspiracist beliefs scale				
R2D:4D	.045	.654	-.03	.763
L2D:4D	-.012	.904	-.006	.948
D _(R-L)	.105	.298	-.036	.723

Note. All correlations are Pearson's (two-tailed).

The current study attempted to replicate these findings, and also to investigate whether 2D:4D is associated with belief in conspiracy theories. It was hypothesised that correlations would be in the positive direction.

No significant relationships were observed between digit ratio and belief in superstitions or the paranormal, casting doubt on the premise that development of such beliefs might be related to differential exposure to prenatal sex hormones. Although this was a clear failure to replicate the findings of Voracek (2009), it should be noted that there were some important differences between the two studies. Firstly, although the measures of superstitious belief used were the same (albeit those administered by Voracek were in German), Voracek utilised the Sheep-Goat Scale to measure paranormal beliefs,

whereas the current study used the Revised Paranormal Belief Scale. However, as these essentially aim to assess the same construct, it is unlikely that this difference fully explains the discrepant findings. Another difference is that participants in Voracek's study came from the general population, whereas those who took part in the current research were university students (however, it is noted that Rogers et al., 2017 partially replicated Voracek's findings using a student sample). Of further relevance is that Voracek's sample ($n = 1118$) was considerably larger than that of the current study ($n = 211$), and the associations observed were weak (1–3 per cent attributable variance). This may, therefore, imply that the current study lacked the level of statistical power required to reliably detect such effects. However, it should also be

considered that the sample utilised by Rogers et al. ($n = 275$) was comparable to that of the current study, albeit still somewhat larger.

No significant associations were observed between 2D:4D and conspiracy beliefs. This was the case for beliefs in well-known conspiracy theories, as well as for the general tendency to believe in such phenomena. A potential reason for the null findings is that belief in conspiracy theories is not necessarily inconsistent with a naturalistic worldview (exemplified by the fact that high profile conspiracy theories have occasionally been proven to be correct, e.g. Watergate). This makes them subtly different from the other types of belief examined here. A further observation of interest is that, unlike for each questionnaire relating to superstitions or the paranormal, no significant sex differences were observed for either measure of conspiracy belief. Given the idea that 2D:4D relates to traits that are sexually dimorphic, this may be relevant in explaining why no significant correlations were observed.

Conclusion

The current study aimed to investigate whether the 2D:4D ratio, a putative indicator of prenatal sex hormone exposure, is associated with belief in the paranormal, superstitions, or conspiracy theories. No evidence of such relationships was observed, which may cast doubt on the idea that the development of these personality constructs is influenced by differential exposure to foetal testosterone and/or oestrogen. However, as the study utilised a relatively small and homogeneous sample of university students, the null findings may be explainable in terms of insufficient statistical power. Further research is therefore required for firm conclusions to be drawn.

Correspondence

Dr Gareth Richards

Research Associate, Autism Research Centre
University of Cambridge
gvr22@medschl.cam.ac.uk

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