



## Who wants to believe? Associations between digit ratio (2D:4D) and paranormal and superstitious beliefs

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### ABSTRACT

Associations of paranormal and superstitious beliefs with digit ratio (2D:4D) and absolute finger length (putatively indexing prenatal and pubertal-adolescent androgen levels, respectively), fluctuating asymmetry (FA; indexing developmental instability), and body measures at birth (indexing non-optimal fetal growth) were examined in a sample of 1118 adults. Higher (feminised) 2D:4D correlated with stronger beliefs in men, even when controlled for age, education, adult height and weight, and birth length and weight. Shorter (feminised) finger length correlated with more superstition among women, but not when controlled for the same covariates. Finger FA was unrelated to beliefs in both sexes. Shorter birth length (in men and women) and lighter adult weight (in women) were associated with stronger beliefs. Effects of 2D:4D on men's beliefs were weak (1–3% attributable variance), but commensurable with those of known non-biological belief correlates (age: 1%; education: 2%). This evidence may be informative for narrowing down possible developmental pathways of paranormal and superstitious beliefs. Propensities contributing to sex and individual differences in these beliefs probably arise in utero, may partly be due to prenatal testosterone and other prenatal programming effects, but less likely due to pubertal-adolescent androgen action or developmental instability.

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### 1. Introduction

Belief in paranormal phenomena is common and thus a widely studied individual difference variable. Replicated demographic correlates of paranormal beliefs include sex, age, and education. The sex effect therein is notable, with women generally showing higher levels of paranormal beliefs than men (Lindeman & Aarnio, 2006), whereas effects of age and education are less conspicuous and less replicable. However, several studies indicate that age is a positive correlate of paranormal beliefs (Lange & Thalbourne, 2002) and length or level of education a negative correlate (Aarnio & Lindeman, 2005). The latter finding may partly be due to several concomitant cognitive factors, since reduced analytical thinking style, reduced reasoning ability, and increased intuitive thinking style are observed in both paranormal believers and the less educated (Hergovich & Arendasy, 2005; Lindeman & Aarnio, 2006).

The underlying factors influencing the consistently observed sex difference in paranormal beliefs are less clear. Generally accepted criteria for assuming a role of biological factors for sexually differentiated traits include the early emergence of the sex difference, its cross-cultural and cross-temporal consistency, and evidence for plausible links between the sexually differentiated trait

and sex differences in possibly underlying biological factors, such as sex hormones or brain structures (Lippa, 2005).

In this context, research on the dimensionality and psychometric correlates of paranormal beliefs is relevant. There is evidence that paranormal beliefs, coalescing with superstitious and magical beliefs, psychometrically form a single higher-order factor (Lindeman & Aarnio, 2006). A well-known personality correlate of paranormal beliefs is schizotypy (Hergovich, Schott, & Arendasy, 2008). Specifically, the magical thinking component of paranormal beliefs is also conceptualised as one facet of schizotypal traits. Among the latter ones, the unusual experiences factor is the strongest correlate of paranormal beliefs (Goulding, 2005). Unusual experiences comprise various aberrant beliefs and perceptions, which in turn tap core positive symptoms of psychosis (particularly, schizophrenia), such as delusions and hallucinations. Paranormal belief may therefore be indicative of psychopathology and for this reason is important to study.

Similar to paranormal beliefs, there are well-known sex differences in schizophrenia (Häfner, 2003), a substantially neurodevelopmentally influenced disorder, whereby women show later onset and better course than men (Riecher-Rössler & Häfner, 2000). These features have been partly attributed to possible sex-hormonal influences, specifically to normal estradiol levels as a protective factor for schizophrenia among premenopausal women (Halbreich & Kahn, 2003). Indeed, studies have shown lowered sex-hormone levels in schizophrenic patients (low estradiol levels

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in psychotic women: Huber et al., 2001; low testosterone levels in psychotic men: Huber, Tettenborn, Leifke, & Emrich, 2005). All of this points to a possible role of sex hormones for a suite of related or overlapping traits that include paranormal beliefs, schizotypy, and psychosis-proneness. Such sex hormonal influences may arise developmentally early, with the commonality consisting in (possibly sex-specifically) altered or disturbed hormonal profiles.

The second-to-fourth digit ratio (2D:4D; Manning, Scutt, Wilson, & Lewis-Jones, 1998), a popular anatomical individual difference variable, is currently held as a putative marker for the permanently (organizational) masculinising effects that prenatal androgens (particularly, testosterone) exert on the brain, behaviour, and physique (Manning, 2002). Human 2D:4D is lower in men than in women, which is apparently due to men having a longer ring finger (4D) relative to their own index finger (2D) than women. Sex and individual differences in 2D:4D emerge prenatally (Malas, Dogan, Evcil, & Desdicioglu, 2006), show little plasticity thereafter (Trivers, Manning, & Jacobson, 2006), and the testosterone-to-estradiol ratio in the amniotic fluid is a negative correlate of children's 2D:4D (Lutchmaya, Baron-Cohen, Raggatt, Knickmeyer, & Manning, 2004). Several recent studies (Arató, Frecska, Beck, An, & Kiss, 2004; Daly, Gooding, Jessen, & Auger, 2008; Procopio, Davies, & Marriott, 2006; Walder, Andersson, McMillan, Breedlove, & Walker, 2006) have investigated associations of 2D:4D or related finger-length measures with schizophrenia or schizotypy. Although findings have not been wholly consistent, the overall evidence (review: Voracek, 2008) is indicative for a higher (feminised or demasculinised) 2D:4D in these conditions, relative to normal healthy population controls.

Given the above reviewed trait associations between paranormal beliefs, schizotypy, and risk for schizophrenia, along with evidence for possible influences of the prenatal sex-hormonal milieu on schizotypal traits and schizophrenia (as indicated by 2D:4D studies), sex and individual differences in paranormal beliefs might as well be partly influenced by prenatal sex-hormone levels. This in turn might advance the understanding of these psychiatric disorders. No study has investigated the associations between paranormal beliefs and digit ratios. In order to fill this gap in the research literature, this study addressed this issue in a large sample of adults.

Digit ratios are obtainable for the right and left hand (R2D:4D and L2D:4D). An additional pointer to prenatal androgen levels is the right-minus-left difference in digit ratios ( $D_{R-L}$ ), because it is also lower in men than in women (Manning, 2002). This alternative measure was therefore also included in this study. In line with the findings from studies on 2D:4D and schizotypy or schizophrenia and on the basis of the direction of the sex difference in paranormal beliefs, 2D:4D and  $D_{R-L}$  were expected to be high (female-typed) in believers.

Furthermore, absolute finger length is not merely a proxy for adult height (rather, correlations are only moderately positive). It is a putative marker of pubertal-adolescent androgen levels, because sex differences therein are negligible before onset of puberty, but large among adults (Jackson, 2008; Lippa, 2006). Fluctuating asymmetry (FA), the random deviation of bilateral bodily traits from perfect symmetry, is a widely studied marker for developmental instability due to the cumulative effects of environmental and genomic stress (Kowner, 2001; Møller & Swaddle, 1997). Reduced fetal growth is associated with a range of chronic somatic and mental conditions in later life (Barker, 1998). Specifically, lower birth weight (Rifkin, Lewis, Jones, Toone, & Murray, 1994) and shorter adult height (Nopoulos, Flaum, Arndt, & Andreasen, 1998) have been found in schizophrenia (of which paranormal beliefs are a known antecedent and positive correlate). To potentially disentangle different biologically based sources of influence on paranormal beliefs, finger length, finger FA, and body measures at birth

and in adulthood were additionally included in the study and were hypothesised to be negatively related to paranormal beliefs (except for finger FA, for which positive associations were expected).

Although paranormal and superstitious beliefs contribute to the same higher-order factor (Lindeman & Aarnio, 2006), it is also true that past research used instruments that exclusively tapped negative superstition, thereby omitting positive superstition. Positive superstitious beliefs, although substantially positively correlated with negative superstitious beliefs, may, to some extent, still be conceptually different from the latter ones (e.g., positive superstition shows higher endorsement rates and larger sex differences; Wiseman & Watt, 2004) and were therefore also included in this research.

## 2. Methods

### 2.1. Participants

1118 self-reported heterosexual native Austrians (491 men, 627 women), sampled from a variety of living conditions and educational and occupational backgrounds, volunteered to participate in this research. Ages ranged from 17 to 72 years ( $M = 30$ ,  $SD = 11.5$  years), and years of education from 8 to 19 years ( $M = 12.4$ ,  $SD = 2.3$  years), with no sex differences in these variables.

### 2.2. Measures

#### 2.2.1. Paranormal beliefs

A German version of the 18-item Australian Sheep-Goat Scale (ASGS; Lange & Thalbourne, 2002) was developed according to the parallel blind technique (Behling & Law, 2000). Discrepancies between individual draft translations of three investigators were resolved consensually. The widely used ASGS assesses paranormal beliefs and experiences (whereby "sheep" and "goats" stand for believers and disbelievers in paranormal phenomena) that pertain to three highly interrelated core domains (extrasensory perception, psychokinesis, and belief in afterlife). For convenience, the visual analogue scale format originally devised for the ASGS was modified to a 6-point scale (0: *Totally disagree*, 5: *Totally agree*). Internal scale consistency in the sample was  $\alpha = .94$ . Exploratory factor analysis (principal components method) extracted three factors with eigenvalues  $\lambda > 1$ , with a steep decline between the first and second factor of the unrotated solution ( $\lambda = 8.70$  and 1.82, with 48.3% and 10.1% attributable variance, respectively). On this account, the translated instrument was considered reliable and having an internal structure characterised by a dominant first factor (Thalbourne & Delin, 1993).

#### 2.2.2. Superstitious beliefs

Similarly, a German translation of a scale measuring superstitious beliefs (Wiseman & Watt, 2004) was prepared and administered with the same response format as the ASGS. This 6-item measure assesses both negative (walking under a ladder, breaking a mirror, the number 13) and positive (crossing fingers, touching wood, carrying a lucky charm) superstition. Cronbach's  $\alpha$  for the total scale was .84. Factor analysis extracted two factors with  $\lambda > 1$ , with a steep decline between the first and the second one ( $\lambda = 3.33$  and 1.01, explaining 55.5% and 16.9% of the variance). On this evidence, the translated instrument was deemed reliable and factorially practically unidimensional.

#### 2.2.3. Finger-length measures

Following standard practice (Voracek, Manning, & Dressler, 2007), palmar-view photocopies of participants' right and left

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