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Digit ratio predicts eminence of Polish actors

Maciej Karwowski *,[1], Izabela Lebuda *,[1]

Department of Educational Sciences, Academy of Special Education, Szczesliwicka St., 40, 02353 Warsaw, Poland

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ABSTRACT

This study examined the relationship between prenatal testosterone exposure assessed by second-to-fourth digit ratio (2D:4D) and the eminence of Polish actors. The eminence of almost one hundred (N = 98) famous Polish male and female actors whose hand prints were in a hall of fame in Miedzyzdroje, Poland was assessed by independent judges; data on their productivity and fame were also collected. The digit ratio predicted the eminence of the actors, and this relationship was significant even when controlling for gender and age. The path model showed that eminence was also predicted by actors' productivity and fame and fame mediated the relationship between productivity and eminence.

1. Introduction

Are there biological underpinnings for creativity? Both classic (Galton, 1869) and contemporary works (Jung et al., 2010) have suggested that this is the case. Eysenck's (1993, 1995) well-known creativity theory treated psychoticism as a key factor contributing to the trait creativity and thence to creative achievement, mainly through overinclusion (Fodor, 1995), latent inhibition (Benedek, Franz, Heene, & Neubauer, 2012; Dorfman, Martindale, Gassimova, & Vartanian, 2008; White & Shah, 2006) and cortical arousal (Martindale, 1981). According to Eysenck (1993, 1995), psychoticism is caused by genetic determinants and the hippocampal formation, which is associated with the neurotransmitters dopamine and serotonin. Recent meta-analyses have confirmed the relationship between psychoticism and creativity (Acar & Runco, 2012) and between creativity and schizotypy (Acar & Sen, 2013), another trait with a strong biological basis (Claridge & Broks, 1984).

During the last decades, it has also been shown that divergent thinking is predicted by biochemical measures of N-acetyl aspartate (NAA) in grey matter regions within the anterior cingulate gyrus (Jung et al., 2009). It has also been demonstrated that specific genes (particularly the dopamine transporter gene – DAT) are associated with fluency of thinking (Reuter, Roth, Holve, & Hennig, 2006; Runco et al., 2011). However, studying biological determinants of creativity is difficult because of the complex nature of this construct (Dietrich, 2004), which has been operationalised in many different ways including divergent thinking, insight, creative activity and creative achievement. Another problem is caused by the domain specificity of creativity, for instance, there are more differences than similarities between the typical personality profiles for creative artists and scientists (Feist, 1998). This study investigated possible relationships between the relative prenatal testosterone and prenatal oestrogen exposure (Manning, 2011; Manning, Scutt, Wilson, & Lewis-Jones, 1998; Zheng & Cohn, 2011) measured by second-to-fourth digit ratio (2D:4D), and the eminence of actors. To our knowledge, there has been no previously published study on the relationship between 2D:4D and creative achievement. We focused on actors because of the unique characteristics of the acting domain and because specifics of their personality type have been reported in previous research. Actors are typically more extrovert (Marchant-Haycox & Wilson, 1992), more emotionally expressive (Friedman, Prince, Riggio, & DiMatteo, 1980), higher in neuroticism, more open to experience and agreeable, and more empathic (Nettle, 2006) than members of other professions. In a recent study, the emotionality component of the HEXACO model was associated with lower prenatal testosterone exposure (Shaw, 2013). This led us to predict that actors' eminence would be negatively associated with prenatal testosterone exposure.

1.1. Prenatal testosterone–oestrogen ratio and 2D:4D

Exposure to gonadal steroid hormones between the thirteenth and fourteenth week of prenatal life (Manning, Bundred, Newton, & Flanagan, 2003) affects the organisation of the central nervous

* Tel.: +48 600456102 (M. Karwowski).
E-mail addresses: maciek.karwowski@gmail.com (M. Karwowski), izalebuda@gmail.com (I. Lebuda).
[1] Both authors contributed equally to this work and thus share the first authorship.

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system (Bardin & Caterall, 1981; McEwen, 1981). Androgens and oestrogens also affect traits connected with sexual dimorphism and physique, for example determining palm shape. Testosterone is responsible for the growth of the fourth digit and oestrogen for the growth of the second digit, so 2D:4D is seen as an indicator of systematic differences in prenatal androgen exposure (Hönekopp & Watson, 2010). High levels of prenatal testosterone and low levels of prenatal oestrogens are associated with a low 2D:4D; men usually have a lower 2D:4D than women, and it is not associated with body mass or height (Hönekopp & Watson, 2010; Manning, 2002). Right-hand 2D:4D is more sensitive to prenatal testosterone than left-hand 2D:4D (Manning, 2002).

The impact of steroid hormones in prenatal development, as indicated by the 2D:4D is associated with certain behavioural patterns, personality traits and biologically based abilities. Exposure to androgens determines amongst other things, propensity to attack and dominate, and promotes risk-taking and competitive behaviour (Manning, 2002; Neave, Laing, Fink, & Manning, 2003; Wilson, Near, & Miller, 1996) and higher confidence (Boissy & Bouissou, 1994). In males, it has also been negatively associated with sensation seeking (Fink, Neave, Laughton, & Manning, 2006).

Androgens and oestrogens also affect the intensity of certain personality traits. Women with high levels of testosterone perceive themselves to be self-directed, action-oriented and resourceful, whereas women with lower levels of testosterone view themselves as conventional and sociable (Collar & Hines, 1995). A study using Cattell's 16 Personality Factors (16PF) questionnaire showed that women with a higher right-hand 2D:4D had lower emotional stability and social boldness and scored higher for 'privateness' (Lindová, Hrušková, Pivoňková, Kuběna, & Flegr, 2008). Studies taking into account the relationship between Big Five personality traits and 2D:4D have not produced consistent findings. For women, these studies have found a significant, positive correlation between neuroticism and right-hand 2D:4D, but also, surprisingly, a negative relationship between the right-hand digit ratio and agreeableness (Fink, Manning, & Neave, 2004).

Hormones determining 2D:4D also influence the development of abilities. Mrazik and Dombrowski (2010) suggested that high intelligence is linked to high prenatal testosterone levels through the latter's influence on neuronal proliferation, migration, differentiation, and apoptosis. Prenatal testosterone exposure may directly influence intelligence by altering neuronal migration, leading to greater right hemisphere development (Geschwind & Behan, 1982), as well as greater coordination within and between the hemispheres (Alexander, O'Boyle, & Benbow, 1996; Anderson & Harvey, 1996).

People who experienced high prenatal exposure to testosterone (low 2D:4D) also have a lower level of verbal skills (Manning, 2002), but better spatial skills (Csatho et al., 2003; Puts, McDaniel, Jordan, & Breedlove, 2008), visual, mathematical and musical skills (Luxen & Buunk, 2005; Sluming & Manning, 2000). High prenatal testosterone levels are associated with achievements in different domains: financial trading (Coates, Gurnell, & Rustichini, 2009) and sports disciplines including rugby, sprinting, running and sumo wrestling (Bennett, Manning, Cook, & Kilduff, 2010; Manning, Morris, & Caswell, 2007; Tamiya, Lee, & Ohtake, 2012).

1.2. 2D:4D and creativity

Studies on the relationship between 2D:4D and creativity are scarce. It has been shown however, that androgen exposure is associated with aesthetic preferences in childhood (Turgeon, 2008) and career interests (Weis, Firker, & Hennig, 2007). In a study of British Symphony Orchestra musicians, male musicians had lower mean 2D:4D in both left and right hands than controls and their 2D:4D was negatively correlated with their rank in the orchestra (Sluming & Manning, 2000). Another study (Karwowski & Lebuda, 2013) demonstrated that 2D:4D was correlated with appreciation of creativity (creative personal identity); the correlation was positive for men, but negative for women, in line with theories of the androgyny of creativity (Csikszentmihalyi, 1996).

As professional creativity is highly domain specific (Baer & Kaufman, 2005), and acting is a profession with specific requirements which are related to the constant contact with spectators and the importance role of empathy, we predicted a positive relationship between actors' creativity and their 2D:4D (and therefore a negative association with prenatal exposure to testosterone). Tendencies to dominate and compete, typical of high prenatal exposure to testosterone, are more characteristic of prominent scholars (Csikszentmihalyi, 1996; Feist, 1998) than actors (Nettle, 2006).

In accounting for excellence in the acting profession we also took into account their productivity and fame. Based on several studies of the psychology of creativity (Simonton, 1997) covering various fields of creativity (e.g. science; Feist, 1993), we predicted that both productivity and fame (Simonton, 1986) would be positive predictors of eminence and that fame would mediate the relationship between productivity and eminence.

1.3. The present study

This study examined the relationship between 2D:4D and eminence in the acting profession. Taking into consideration the requirements of the profession, we predicted that the success of an actor would be negatively associated with prenatal exposure to testosterone; hence we predicted a positive association between eminence and 2D:4D (Hypothesis 1). Secondly, we hypothesised that actors' productivity and fame would predict their eminence (Hypothesis 2), with fame serving as a mediator of the association between productivity and eminence (Hypothesis 3).

2. Method

2.1. Participants and procedure

A total of 98 Polish actors (61 male and 37 female) born between 1912 and 1978 (age: $M = 68.05$, $SD = 14.62$) whose hand prints were in a hall of fame in Miedzyzdroje, Poland (71 right hands and 27 left hands) formed the sample. The hand prints were imprinted in the concrete, and the finger tips were highly visible. Examples of hand prints (of slightly lower quality) may be found at http://pl.wikipedia.org/wiki/Plik:Al_Gwiazd_Tyszkiewicz_beax.jpg. In previous studies 2D:4D data were obtained in a similar way, with high reliability (Ronalds, Phillips, Godfrey, & Manning, 2002; Tamiya et al., 2012). The hands were photographed with a high quality camera and then the second and fourth digits were measured twice, by two independent coders, using a record measurement programme in Adobe Photoshop. Measurements were made with the photographs enlarged to 200% original size. The unit of measurement was the pixel – the smallest available unit.

2.2. Measures

2.2.1. Digit ratio

The second and fourth fingers on each of the 98 photographs were measured twice, by two independent coders. The intra-class correlation (ICC) between measurements was high for both the second digit ($ICC = .998$; $p < .001$) and the fourth digit ($ICC = .997$; $p < .001$). The 2D:4D was computed by averaging the second digit and fourth digit measurements separately, then dividing the average for the second digit by the average for the fourth digit.