



## 2D:4D As An Alternative Measure for Sex: Focus on Aggression

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### ABSTRACT

*2D:4D ratio has been successfully used as a representative for the amount of prenatal androgens exposure. This exposure during the critical period of intrauterine development causes the masculinisation of human embryo and – subsequently – its male features. The amount of masculinisation therefore affects the future presence of masculine features in psychological characteristics. The aim of the pilot study is to explore whether fluent 2D:4D ratio is more sensitive within masculine/feminine manifestations of sexually dimorphic psychological characteristics (example of an aggression) than simple category man/woman.*

*Subjects (N=134) were young adults (mean age 21,40) of which 47% were male. Comparing aggression between men and women did not show significant differences (sig=0,257). On the other hand, correlation between 2D:4D and aggression was statistically significant (p=0,011). According to the results, the 2D:4D ratio can be considered as more accurate for distinguishing masculinity/femininity in psychological characteristics than simple belonging to sex.*

**KEYWORDS :** 2D:4D, sexual dimorphism, aggression

### Introduction

#### Sexual Dimorphism

Sexual dimorphism in psychological features is based on the intrauterine development, which is different for feminine and for masculine embryos. Non homologous part of the Y chromosome contains SRY gene, which determines maleness (Demuthova & Blazek, 2007). SRY gene is activated during the 6<sup>th</sup> week of intrauterine development and consequently cells create **testosterone**, dihydrotestosterone, and **antimüllerian hormone** to turn embryo into male one (Wilson, 1999). When androgens (mainly testosterone) are present, the cascade of changes on remaining 22 chromosomes starts and the embryo changes into future male individual (Moir & Moir, 2000). Masculinisation of the human embryo creates the differences compared to female development trajectory in many areas. Besides visible physical changes in organism, the brain is being built and organized differently, what causes changes in behaviour and psychical characteristics of two sexes (Eliot, 2009).

#### 2D:4D ratio

2D:4D ratio has been successfully used as a substitution for the measurement of the amount of prenatal androgens exposure (Manning, Kilduff, & Cook et al., 2014), while the 2D:4D ratio represents the length of the index (second) finger divided by the length of the ring (fourth) finger. The high prenatal levels of androgens refer to low values (male type) of 2D:4D. Contemporary anthropological, medical, and psychological (Manning, 2002) studies have found connections between 2D:4D and various somatic (Muller, Giles, & Bassett et al., 2011; Zhao, Yu, & Zhang et al., 2013; Garcia-Cruz, Huguét, & Piqueras et al., 2011) as well as psychological characteristics (Kilduff, Hopp, & Cook et al., 2013; Burton, Guterman, & Baum, 2013; Garbarino, Slonim, & Sydnor, 2010).

Our question is, whether the 2D:4D ratio can be more distinctive than simple sex category man/woman when it comes to various psychological features bonded to sex. Aggression has been chronically used as an example of the typical male feature mostly due to the higher levels of testosterone (Räsänen, Hakko, & Visuri et al. 1999; Canter, 2010; Pascual-Sagastizabal, Azurmendi, & Braza et al., 2014) with its higher prevalence in males. We therefore assume that the levels of general aggression should be also tight to 2D:4D. Subsequently, an aggression can be used as an example of the test variable when exploring the possibility of 2D:4D to be as an alternative measure for sex category man/woman.

### Method

#### Participants

The sample of the pilot study consisted of 134 university students of

the bachelor degree at the University of Ss. Cyril and Methodius in Trnava, Slovakia. They assigned to participate on the study on a voluntary basis. The sample was gender heterogeneous; 53% of students (n =71) were female. Age of the tested group ranged from 18 to 27 with the mean value 21,40 (st. dev.=1,61).

#### Measures

2D:4D ratio refers to the length of the second (index finger) compared to the length of the fourth finger (ring finger). It is commonly measured as the length from the midpoint of bottom crease (where the finger joins the hand) to the tip of the fingers. There are questions whether to prefer right hand or left hand for the measurement, however the results show that both of them refer to the amount of prenatal androgen exposure (Manning, 2002). We took a measure individually from both – the right and the left hand and used their mean value. Also, there are several ways of taking the measure – by the x-ray of hands, by the photocopies, or by the ruler/vernier caliper. We preferred the direct measurement by a ruler as the photocopying requires the hand to be pressed against a glass plate which causes different outcome on the tips of fingers due to differences in the fat pads (Burriss, Little, & Nelson, 2005). Ruler was transparent with the resolution of 0,5 millimetre. The level of aggression has been measured by the Buss-Durkee Hostility Inventory (Buss 1957; Buss & Durkee 1957) using the overall score.

#### Results

According to the Shapiro-Wilk W test (Table 1), the distributions of researched variables were not normal (p<.05 in both cases). Also, the values of skewness and kurtosis in 2D:4D (out of the range -2 and +2) recommend the use the nonparametric tests of further analysis. This was executed through the Mann-Whitney U test and Spearman correlation in SPSS program version 16.

#### Table 1 about here

**Table 1 - Descriptive statistics and tests of normality of the examined variables**

variable	Min	Max	Med	SD
2D:4D	0.83	1.49	-	-
aggression	15.00	59.00	32.00	9.23
variable	Skew.	Kurt.	sig.	
2D:4D	4.90	42,13	0.000	
aggression	0.56	0.04	0.006	

Note. <sup>a</sup>SE<sub>skewness</sub>=**0.209**; SE<sub>kurtosis</sub>=**0.416**

Our goal was to explore whether the scale variable 2D:4D could be more distinctive than bipolar variable man vs. woman in relation to aggression. To test the differences in aggression between sexes, the nonparametric Mann-Whitney U test was used. The Table 2 shows that there weren't significant differences ( $p > .05$ ) in aggression between men and women.

### Table 2 about here

**Table 2 - Differences in aggression between men and women**

sex	verbal abilities			U	sig.
	N	%	Mean Rank		
woman	71	53	71,58	1979,50	0.257
man	63	47	63,88		

Usually, such results would be interpreted as a non-existence of the differences between sexes. However, we assume that the differences do exist, but the differentiation between men and women is too rough and simple. As it was mentioned, being a man or a woman could be considered as biological representation of the extremes of the overall masculinization during (and even after) the intrauterine development. The psychological features sensitive to the amount of androgens in utero display scale character. Therefore 2D:4D could be more accurate to express the maleness/femaleness in psychological means than the simple categories man/woman. This presumption support the outcomes of Spearman correlation between aggression and 2D:4D in the table 3.

### Table 3 about here

**Table 3 - Spearman correlation between aggression and 2D:4D**

2D:4D	aggression	
	Correlation Coefficient	.220*
Sig. (2-tailed)	.011	
N	134	

Note. \* Correlation is significant at the 0.05 level (2-tailed)

In spite of nonexistence of the differences between men and women in aggression, the table 3 shows significant ( $p < .05$ ) negative correlation between aggression and 2D:4D. The outcome is the higher the aggression is the lower (more masculine) is the digit ratio (2D:4D). These results point out to the possibility, that 2D:4D can be more distinctive variable than simple sex, mainly when it comes to psychological features affected by the androgens playing their critical role during intrauterine development.

### Conclusion

Male-female differences have always been fodder for controversy and in last decades the topic has taken also political turn (Eliot, 2009). Equality in upbringing, education, chances, etc. has been questioned by the fact that it is impossible to expect boys and girls, men and women to perform and behave the same. The question is, whether this attitude is fair. It is not rare that inter-individual differences in certain characteristic between two subjects of the same sex can be bigger than those between two sexes. Dividing the whole population into two groups only logically ends up in very rough discrimination. If the maleness/femaleness is the outcome of the amount of formative testosterone levels in utero, sex (being man or woman) can be considered (to some extent) as two extremes of a fluent variable referring to masculinisation of the brain.

We tested the presumption that 2D:4D could be more accurate to express the maleness/femaleness in psychological means than the simple categories man/woman. Our results prove the existence of the significant correlation between the aggression and left-hand 2D:4D. These results are in concordance with the outcomes of Manning (2002) who found a strong association between 4D and aggression in young boys. However, there is a strong need for larger and more representative sample together with the further verification with use of other methods and other psychological variables de-

pendent on sex.

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