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Digit ratios as correlates of accident involvement and aggressive driving – a pilot study

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Abstract

This exploratory study focuses on the relationship between the right hand digit ratio, aggressive driving behavior, and the individual accident involvement rate. Data was collected from 150 right-handed male drivers and two different ratios were computed. The results indicate that the digit ratio significantly correlates with the individual number of traffic accidents, but not with the expressions of aggressive driving. These findings are in line with the studies which state that specific digit ratios are good markers of prenatal testosterone exposure. They also provide some support for the digit ratio as a potential predictor of accident proneness.

Keywords: digit ratio; 2D:4D; rel2; accident involvement rate; aggressive driving.

1. Introduction: The digit ratio as testosterone indicator

Prenatal exposure to testosterone is essential in the appearance of sexual dimorphism and partially responsible for a variety of behavioral and cognitive differences between genders that manifest later in life (Cohen-Bendahan, van de Beek, & Berenbaum, 2005). Since it is not easy or ethical to directly measure the level of prenatal testosterone in

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human fetuses, researchers must rely on indirect methods. One such method is to measure the length of the hand fingers and to compute different digit ratios.

The ratio between the index finger (2D) and the ring finger (4D), also known as the 2D:4D ratio, has been studied for years as a reliable indicator of prenatal exposure to androgens, especially testosterone. The 2D:4D ratio is the strongest measure of sexual dimorphism out of all the possible digit ratio combinations (McFadden & Shubel, 2002). Studies show that men tend to have smaller 2D:4D ratios than women, because their index finger is generally shorter than the ring finger (Manning, 2002). Also, the sexual dimorphism of the 2D:4D ratio is much more prominent for the right hand, both in humans and other species (Brown et al., 2003; McFadden & Shubel, 2002; McFadden & Bracht, 2003). The 2D:4D ratio is not a typical sexual dimorphic trait, because it does not change significantly across the years, like secondary sexual traits do (Trivers, Manning & Jacobson, 2006) and does not correlate with the levels of sexual hormones in adults (Hönekopp, Bartholdt, Beier, & Liebert, 2007).

1.1. The 2D:4D ratio

If 2D:4D ratio indicates the level of prenatal testosterone exposure and aggressiveness has been related to testosterone, then it can be stated that individuals with a lower 2D:4D ratio, meaning that they were exposed to a greater quantity of prenatal testosterone, will be much more aggressive regardless of their gender (Manning, 2002). However, the studies carried out in this direction were not able to establish a definite conclusion. The general pattern seems to be that physical aggressiveness correlates with a low 2D:4D ratio only in men (Bailey & Hurd, 2005; Kuepper & Hennig, 2007). Women with low 2D:4D ratios manifest a covert aggressiveness, such as spreading rumors (Coyne et al., 2007). There is a lack of studies concerning the relation between the 2D:4D ratio and displaying aggressiveness in traffic and this research tries to shed some light on this matter.

Although individuals considerably vary across their willingness of taking chances, it seems that men have the tendency to display risky behaviors in a greater extent than women (Byrnes, Miller, & Schafer, 1999; Wang, Kruger, & Wilke, 2009). The 2D:4D ratio is a strong predictor for the number of penalty points, even when other relevant demographic and personality variables are controlled (Schwerdtfeger, Heims, & Heer, 2010). Exactly, a 0.01 decrease of the 2D:4D ratio leads to a similar increase of penalty points. Also, the 2D:4D ratio is a stronger predictor for penalty points than driving experience.

1.2. The 'rel2' ratio

Loehlin, Medland & Martin (2009) have emphasized the reliability of another digit ratio as an indicator of prenatal exposure to testosterone, namely *rel*2. This indicator compares the length of a finger with the sum of the lengths of all the other fingers. In other words, *rel*2 is the ratio between the index finger and the sum of all the other four hand fingers and it can be determined by using this formula: 2D/(2D+3D+4D+5D). Using a sample of 800 teenagers, Leohlin, Medland & Martin (2009) reached the conclusion that *rel*2 is better than 2D:4D ratio for gender discrimination.

To sum up, the few studies which have been carried out until now suggest that a low 2D:4D ratio correlates with a larger number of traffic violations. In addition, the body of literature concerning the relation between the 2D:4D ratio and a variety of traffic psychology variables does not provide irrefutable data in this matter, because the results are often contradicting. Therefore, it cannot be firmly stated that the 2D:4D ratio is a reliable prenatal exposure to testosterone indicator.

2. Aims and hypotheses

The first goal of this pilot study is to see whether finger ratios can predict aggressive driving, the number of traffic violations, and the individual accident involvement rate. The second goal is to find out which of the two digit ratios (2D:4D or *rel*2) could act as better predictor for the three dependent variables. The hypotheses state that there is a significant negative correlation between the 2D:4D and *rel*2 ratios, on one hand, and the number of traffic tickets, number of accidents, and expressions of aggressive driving, on the other hand.

3. Method

3.1. Participants and procedure

One hundred and fifty right-handed male drivers participated in this study. Their age mean was 28.92 years (SD=10.29), with a mean driving experience of 8.96 years (SD=8.17) and 196699.47 kilometers (SD=361883.75). The participants were briefly informed about the experimental procedure and were assured of the confidentiality of the data they provided. They were then asked to give their consent to have their right hand scanned. Afterwards, their right hand was properly marked and scanned (see Figure 1). During the next step, the Driving Anger Expression Inventory (DAX; Deffenbacher et al., 2002) was filled in by all participants. Then, participants were asked to give information about the traffic tickets they received and the number of accidents they were involved in since they obtained their driving license. The participants were eventually debriefed.

3.2. Measures

The 2D:4D and rel2 ratios. The hands of the participants were scanned and printed using an HP LaserJet M2727nfs multifunction printer with an optical scanning resolution of 1200x1200 dpi and a digital scanning resolution of 19200 dpi. In order to standardize the hand scanning process, all participants were told to place their right hand on the scanner without applying too much pressure, to part their fingers at approximately equal distances and to make sure that there are no spaces between their hands and the scanner. The rules and standards imposed by researchers in the domain were applied: (1) the distance between the most basal crease that cuts the finger perfectly from one side to the other and the finger tip represents the length of the finger; (2) in order to measure the finger, the middle of the basal crease must be established. In order to make the basal crease visible, it was emphasized using a roller pen with a 0.25 mm needle tip. The fingers were measured using a vernier calipers (Lumytools LT15240) with an accuracy of 0.01 mm by two independent evaluators, each of them having to measure the fingers twice.

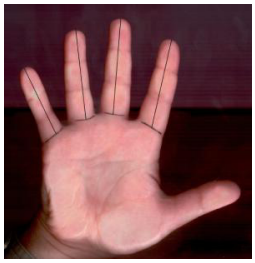

Figure 1. Measurement of the fingers.

Aggressive driving. The Driving Anger Expression Inventory (DAX; Deffenbacher et al., 2002) was used to measure the level of displayed aggressiveness in traffic. DAX contains 49 items, with values from 1 to 4 (1 - never; 2 - at times; 3 - often; 4 - always). High scores indicate a strong tendency to overreact in traffic. The four subscales measure four different forms of anger expression while driving: (1) Verbally Aggressive Expression (α = .88); (2) Physically Aggressive Expression (α = .84); (3) Using the Vehicle for Aggressive Expression (α = .86); and (4) Adaptive/Constructive Expression (α = .90).

The number of accidents and traffic tickets. The individual accident involvement rate was measured by asking each participant to report the number of collisions they were involved in since they obtained their driving license. In addition, they were asked to report the number of traffic tickets received since they began driving.

4. Results

SPSS 17.0 was used in the statistical analysis of data. First, the inter- and intra-evaluator reliability coefficients were computed (see Table 1). The correlations between the measurements carried out by the same evaluator, as well as those between the measurements carried out by both evaluators have extremely high values and are significant. In other words, the differences between the different measurements are very small and insignificant, meaning that they are accurate. After checking the reliability of the finger ratio measurements, we used Pearson correlation to find out whether there is a link between digit ratios and the other measures (see Table 2). The correlation between the 2D:4D ratio and *rel*2 is very high, positive and significant, which means that they are both adequate measures of the digit ratio. However, there is a negative and statistically significant correlation between *rel*2 and the number of accidents, meaning that as the *rel*2 ratio decreases, the number of accidents rises, whilst there is no such correlation between the 2D:4D ratio and the number of accidents. This is an unexpected result, since the correlation between the two digit ratios is very high and significant.

Table 1. Inter- and intra-evaluator reliability coefficients.

	Intra-evaluator reliability		Inter-evaluator reliability
2D:4D	Evaluator 1 r = 0.973; p < 0.01	Evaluator 2 r = 0.995; p < 0.01	r = 0.984; p < 0.01
*rel*2	Evaluator 1 r = 0.976; p < 0.01	Evaluator 2 r = 0.995; p < 0.01	r = 0.990; p < 0.01

Table 2. Correlation coefficients between the variables.

	*rel*2	No. Accidents	No. traffic tickets	Total DAX	VAE (DAX)	PAE (DAX)	UVAE (DAX)	A/CE (DAX)
2D:4D	.905**	-.144	-.128	.085	.112	.067	-.054	.081
*rel*2	1	-.168*	-.126	.062	.076	-.001	-.096	.118
No. Accidents		1	.184*	.025	.071	.144	.150	-.163*
No. traffic tickets			1	-.143	-.159	.072	-.095	-.124
Total DAX				1	.834**	.668**	.726**	.664**
VAE (DAX)					1	.558**	.589**	.256**
PAE (DAX)						1	.516**	.210**
UVAE (DAX)							1	.200*
A/CE (DAX)								1

*p<0.05; **p<0.01

VAE – Verbally Aggressive Expression; PAE – Physically Aggressive Expression; UVAE – Using the Vehicle for Aggressive Expression; A/CE – Adaptive/Constructive Expression

Another statistically significant positive correlation is that between the number of accidents and the number of traffic tickets. This means that as the number of traffic tickets rises, so does the number of accidents. This result is somewhat predictable, since both variables depict reckless and risky driving. Also, there is a negative significant correlation between the number of accidents and adaptive or constructive expression of aggressiveness. This suggests that as long as drivers adopt a constructive way of expressing their negative feelings in traffic more often, the number of accidents will decrease. All of the other significant correlations are predictable because they are between the four different factors of DAX. However, it is noteworthy that no significant correlations were obtained between the 2D:4D and *rel*2 ratios and any of the four DAX factors.

5. Discussion

The only confirmed hypothesis is the one which stated that there is a negative correlation between *rel*2 and the number of accidents. This finding is important because it suggests that the individual accident involvement rate can be predicted by the level of testosterone measured through the finger ratio. Given that the 2D:4D ratio and *rel*2 strongly correlate, and that in turn *rel*2 correlates with the number of accidents, a question arises: Why does not the 2D:4D ratio correlate with the number of accidents? One possible explanation is that *rel*2 is, in fact, much more accurate that the 2D:4D ratio, which practically supports the conclusion reached by Loehlin, Medland & Martin (2009).

Although statistically significant, the correlation between *rel*2 and the number of accidents is weak. This result is in line with the conclusions of other studies which have reported significant but weak correlations between digit ratios and the dependent measures used (Stenstrom et al., 2011; Schwerdtfeger & Heer, 2008; Voracek et al., 2010; Evardone & Alexander, 2009). These results may be caused by the fact that digit ratios are not as stable and solid indicators as expected. On the other hand, this variation may be caused by the instruments themselves. There were no significant correlations between the digit ratios used in the study and any of the DAX factors suggesting that the prediction of aggressive driving based on digit ratios may be problematic.

The most important limitation of this study is the relative small number of participants. It is possible that a larger number of participants would have produced stronger correlations. Another limitation is the use of a self-report instrument, which allows the participants to give socially desirable answers. Future studies should overcome these shortcomings and be conducted on larger samples in order to get a more accurate image of the phenomenon. Being a relatively new direction in traffic psychology, the digit ratio topic should be studied more thoroughly in order to shed more light on its predictive power.

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