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Digit ratio (2D:4D) and prosocial behavior in economic games: No direct correlation

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ABSTRACT

Prenatal exposure to hormones, and to sex hormones in particular, exerts organizational effects on the brain and these have observable behavioral correlates in adult life. There are reasons to expect that social behaviors—which are fundamental for the evolutionary success of humans—might be related to biological factors such as prenatal sex hormone exposure. Nevertheless, the existing literature is inconclusive as to whether and how prenatal exposure to testosterone and estrogen, proxied by the second-to-fourth digit ratio (2D:4D), may predict non-selfish behavior. Here, we investigate this question using economic experiments with real monetary stakes and analyzing five different dimensions of social behavior in a comparatively large sample of Caucasian participants (*n*=560). For both males and females, our results show no robust association between right- or left-hand 2D:4D and generosity, bargaining, or trust-related behaviors. We conclude therefore that there is no correlation between 2D:4D and social behavior in economic games.

INTRODUCTION

Human social behavior captivates researchers from many different disciplines, both in the natural and the social sciences (Axelrod and Hamilton, 1981; Fehr and Fischbacher, 2003; Nowak, 2006). One of the key features of human social architecture is that institutions are often built upon the sporadic cooperation of thousands, sometimes millions, unrelated individuals, and this stands as an evolutionary puzzle: How could behaviors that help others have evolved if they provide a fitness advantage to the recipient(s) over the actor?

Humans display a large set of different manifestations of social behavior including generosity, competition, fairness, trust, and reciprocity to name a few. Each of them seems to have its own particularities and bio-psychological underpinnings (Fehr and Fischbacher, 2003; Ebstein et al., 2010; Corgnet et al., 2016; Espín et al., 2016a). However, while our species shows distinctive behavioral patterns in the social domain compared to other taxa, there is also large individual heterogeneity. Even though we know that one part of the variation emanates from cultural differences (Henrich et al 2005, 2010; Herrmann et al., 2008), considerable heterogeneity still emerges within cultural groups. The objective of this study is to analyze the biological roots of such individual differences.

Given the relevance of social skills and associated behaviors for the evolutionary success of humans, one source of variation might indeed be biological. In fact, many studies—without relying on any particular biological trait—suggest that social behavior is heritable or genetically determined to some extent (Wallace et al., 2007; Cesarini et al., 2008, 2009; Ebstein et al., 2010). Along these lines, different biological and genetic factors at certain times of development might generate predispositions towards different social behaviors (Van Lange et al., 1997; Wingfield et al., 1998; Repetti et al., 2002; Fries et al., 2005). One of such factors may be associated with the amount of hormones individuals are exposed to during prenatal development (Knickmeyer et al., 2005; Auyeung et al., 2009; Berenbaum and Beltz, 2011). Fetal exposure to hormones such as androgens and cortisol is known to exert organizational effects on the human body and brain which may, in turn, influence behavior later in life (Baron-Cohen et al.; 2005; Cohen-Bedehan et al., 2005; Davis and Sandman, 2010; Lombardo et al., 2012). Since hormonal levels are under strong genetic influence (Harris et al., 1998; Bartels et al., 2003), this may represent one possible channel for the intergenerational transmission of behavior.

With regards to social behavior, sex hormones, and androgens in particular, have attracted considerable attention and there is now a plethora of studies on the behavioral correlates of circulating (either endogenous or administered) testosterone levels (Burnham, 2007; Zak et al., 2009; Zethraeus et al., 2009; Bos et al., 2010; Eisenegger et al. 2010, 2011; van Honk et al., 2012).

In this paper, rather than circulating hormones, we focus on the organizational effects of prenatal exposure to testosterone. More specifically, we explore the relationship between fetal testosterone exposure and social behavior in economic experiments. Previous studies have typically used the second-to-fourth digit ratio (2D:4D) as a putative marker of prenatal exposure to testosterone or, more precisely, of the relative exposure to testosterone compared to estradiol while in uterus (Lutchmaya et al., 2004). We also stick to this measure. Although direct evidence for the 2D:4D-fetal sex hormones link only exists for mice (Zheng and Cohn, 2011), rats (Talarovičová et al., 2009; Auger et al. 2013), and birds (Romano et al., 2005), there exists large indirect evidence and the ratio is commonly accepted as a proxy of fetal hormone exposure (also) in humans. 2D:4D is calculated such that lower ratios correspond to higher exposure to testosterone and lower exposure to estrogen. Consequently, males tend to display lower 2D:4D values than females (Manning, 2002). Many studies have analyzed the association between 2D:4D and diverse aspects of social involvement, ranging from status seeking (Manning and Fink, 2008) to positioning in social networks (Kovářík et al., 2017). Others have linked 2D:4D with certain diseases associated to decreased social skills, such as autism (see e.g. Al-Zaid et al. 2015 and Manning et al. 2001).

Regarding the economic games designed to elicit (pro)social preferences, the literature has been inconclusive as to whether and how 2D:4D predicts subjects' social behavior. Some studies report negative effects of fetal testosterone on behaviors such as generosity, cooperation, or trust (Cecchi and Duchoslav, 2018; de Neys et al., 2013), whereas others indicate positive effects on fair or normative behaviors (Millet and Dewitte, 2006, 2009; Van den Bergh and Dewitte, 2006; Ronay and Galinsky, 2011; Buser, 2012). Null and non-linear relationships have also been frequently reported (Miller and Dewitte, 2009; Sanchez-Pages and Turiegano, 2010, 2013; Brañas-Garza et al., 2013; Galizzi and Nieboer, 2015; Parslow et al. 2018). Moreover, other studies find

2D:4D-context interactive effects where situational cues change the relationship between 2D:4D and social behavior. For example, Van den Berg and Dewitte (2006) observe that lower 2D:4D either increases or decreases rejection rates in the UG depending on whether subjects are in a neutral or sex-related context, respectively, whereas Millet and Dewitte (2009) detect either a negative or positive association between 2D:4D and giving in DGs, depending on whether participants are primed with cues of aggression or not.

In sum, the existing evidence provides no specific hypothesis regarding the how 2D:4D organizes prosocial behavior. It is worth noting that some of these papers are based on hypothetical decisions with no monetary consequences.

Three features of this study distinguish it from previous research. First, we use a (comparatively) large sample size that permits for high statistical power. Our sample consists of a total of 560 Caucasian individuals (330 women). This means that we will be able to find a small effect size (specifically, $r = 0.12$) with 80% power and $\alpha = 0.05$. Among the existing economic experiments similar to ours, which effectively measure the participants' fingers length rather than relying on self-reports, the largest Caucasian sample is that in Galizzi and Nieboer (2015) with a total of 201 Caucasians within an ethnically diverse sample of 602 individuals. More recently, Parslow et al. (2018) study a sample of 330 women, but they do not report the ethnicity.

Second, we elicit five dimensions of social behavior using three economic games. All our participants decided, in random order, as Dictators in the Dictator Game (Forsythe et al., 1994), as both Proposers and Responders in the Ultimatum Game (Güth et al., 1982), and as both Trustors and Trustees in the Trust Game (Berg et al., 1995; see Methods). For each subject, we thus gathered measures in the domains of generosity (Dictator Game), bargaining (Ultimatum Game) and trust and reciprocity (Trust Game).

Finally, our dataset allows us to control for a number of potential confounding factors, such as, for instance, cognitive reflection (Bosch-Domènech et al., 2014; Cueva et al., 2016) or risk preferences (Brañas-Garza and Rustichini, 2011; Brañas-Garza et al., 2018).

METHODS

Participants and general protocol

In October 2011, all the first-year students (n=927) at the School of Economics of the University of Granada (Spain) were invited to participate in a survey/experiment at the EGEO Experimental Economics Lab. Participation was voluntary and the number of participants ended up being 659 (71% of the population), distributed in 27 sessions. Students were officially invited to visit the lab by the Dean of the School so that the original objective was *not* to earn money but to visit the lab, reducing potential self-selection issues with participants of laboratory economic experiments (Abeler and Nosenzo, 2015). We consider the participation rate of 71% very high. Once seated in their respective cubicles (which impeded visual contact between them), the students were invited to complete a survey and to play a variety of experimental games using a computer interface. None of those who showed up in the lab refused to participate. In the analysis below, we exclude from the sample individuals with missing values in any of the variables applied in this paper. To ensure ethnic homogeneity (Manning et al., 2007), non-Caucasian subjects were also excluded. The resulting sample size is 560 Caucasian subjects (230 males; age: mean ± SD = 17.97 ±1.82).

In each session, the participants were first asked to fill the socio-demographic and personality characteristics section, including self-reported measures of life satisfaction, self-esteem, risk preferences, and trust in others. In addition, the survey contained a math test with four simple questions. After the survey, the subjects were explained in detail all the economic games they would face and then played all the games in a random order (24 different orders). Once finished with the computerized part, the subjects participated in a paper-and-pencil version of the Cognitive Reflection Test (Frederick, 2005). No time pressure was imposed in any of the stages. In what follows, we explain in detail the elicitation and the structure of our three main variable types.

2D:4D measurement

At the end of each session, the participants were scanned their both hands using a high-resolution scanner (Canon Slide 90). The lengths of the index and ring fingers were measured from the scanned images as the distance from the middle of the basal crease to the tip of the finger using Photoshop (see Neyse and Brañas-Garza, 2014). Computer-assisted measurements of 2D:4D from scanned pictures have been found to be more precise and reliable than measurements using other methods (Allaway et al., 2009; Kemper and Schwerdtfeger, 2009). The 2D:4D of each hand was measured twice at an interval of one month by the same experienced researcher (not involved in this paper). These measurements displayed a high repeatability (right hand: intraclass correlation coefficient (ICC) = 0.9566, $p < 0.001$, left hand: ICC = 0.9440, $p < 0.001$) and were averaged to obtain a single value of the 2D:4D ratio for each hand. As expected, the left-hand and right-hand 2D:4Ds were correlated within individuals ($r = 0.67$, $p=0.000$ for males; $r =0.71$, $p=0.000$ for females; Pearson correlation) and males displayed lower 2D:4D than females (right hand means: $2D{:}4D_M =0.960$, $2D{:}4D_F =0.972$, $p=0.000$; left hand means: $2D{:}4D_M =0.965$, $2D{:}4D_F =0.976$, $p=0.000$; t-test).

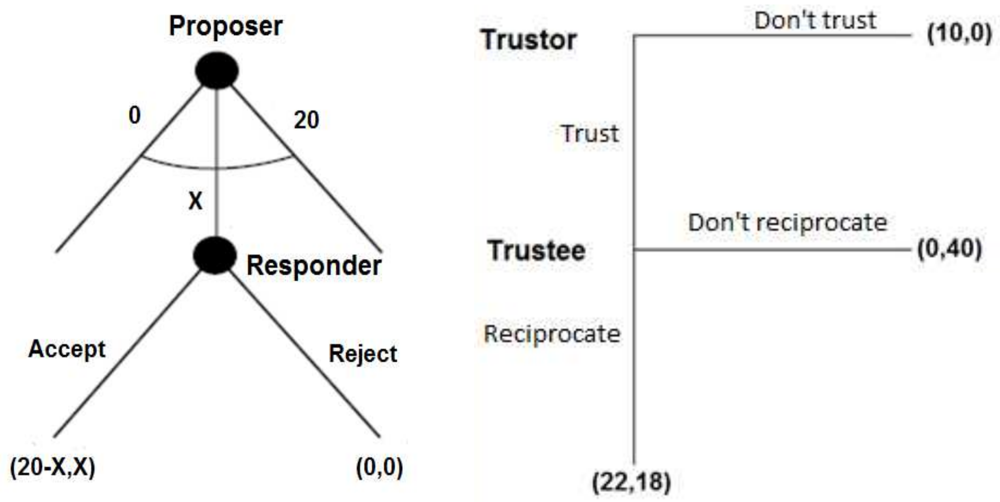
Social behavior measurement - Economic games

Our experiment consists of three canonical two-person games: the Dictator Game (DG, henceforth), the Ultimatum Game (UG), and the Trust Game (TG). The games were faced by each participant in random order and all participants played both roles in each game. For each decision, participants would be matched with a different anonymous individual selected at random among the other participants.

In the DG, one player, the Dictator, had to propose a division of €20 between herself and another anonymous participant, the Receiver, who could not but accept the proposed division. In our experiment, subjects were only allowed to propose the split in €2 increments. Below, we employ the amount of money donated to the other participant (*DG offer*) as a measure of generosity. Even though no subject played the role of the Receiver for obvious reasons, they could actually have been paid for this role if selected to make sure that Dictators' decisions affect others.

In the UG (Güth et al., 1982; see Figure 1), one player, the Proposer, had to propose a division of €20 between herself and another anonymous participant, the Responder, who—in contrast to the DG—could either accept or reject the proposal. If the latter accepted, the proposed division was implemented; in case of rejection, neither participant earned anything. Each subject participated in both roles. The *offer* made to the Responder will be our measure of Proposers' bargaining behavior. For the role of Responder, we used the strategy method: each subject had to state her willingness to accept or reject each of the possible proposals without knowing the offer of the Proposer. Below, we employ the minimum acceptable offer (*mao*, thereafter)—the minimum amount of money that a subject would accept—as our measure of Responders' behavior. Such approach is common in the literature and the *mao* is typically interpreted as indicative for the Responder's willingness to punish the Proposer at a personal cost (e.g. Fehr and Fischbacher, 2003; Henrich et al., 2005; Brañas-Garza et al., 2006, Burnham 2007; Brañas-Garza et al., 2014).

Figure 1. Ultimatum (left) and Trust (right) Games in strategic form implemented in our study. The figure shows the payments (in €) associated to each of the possible outcomes for the Proposer (Trustor) and Responder (Trustee) in the Ultimatum (Trust) Game. The Dictator Game only differs from the Ultimatum Game in that the rejection option does not exist in the second stage and the payoffs consequently are (20-X,X).



As for the TG, we employ a binary version of the game (Ermisch et al., 2009) and again resort to the strategy method. More precisely, one player, the Trustor, had to decide whether to pass €10 or €0 to the Trustee. If she passed €0, the Trustor earned €10 and the Trustee nothing; if she rather passed €10 (i.e., the Trustor trusted the Trustee), the latter would receive 4 × €10 = €40. In such a case, the Trustee had to decide whether to either send back €22 and keep €18 for herself (that is, being trustworthy) or keep all €40 without sending anything back, in which case the Trustor would not earn anything. The Trustor's decision thus measures trust, whereas the Trustee's decision measures positive reciprocity. Figure 1 displays the extensive form of the TG implemented. In the analysis below, *TG trust=1* if the participant chose to pass the money to the Trustee and 0 otherwise. Similarly, *TG reciprocity=1* if as a Trustee the participant chose to return the money to the Trustor and 0 otherwise.

Decisions were not hypothetical. Participants' payoffs were computed according to their decisions in the games and/or those of a randomly matched participant. The identity of the other player remained anonymous. One of every ten participants was randomly selected to be paid, and the final payoff was determined by a randomly selected role. The average earnings of those selected for payment, including those winning €0 (11.43%), were €10.43.

Additional variables

As noted before, we administered all participants a survey eliciting a large amount of information (including *gender*, *age*, *household income, math skills,* and *social capital*). Besides we also include questions on life satisfaction, cognitive abilities and risk attitudes.

We measured participants' subjective well-being through the *life satisfaction* question (Zilioli et al., 2015; Espín et al., 2016b): "*In a scale from 1 to 7, where 1 means 'completely unsatisfied' and 7 means 'completely satisfied', in general, how satisfied are you with your life?*".

In addition, we also control for two measures of cognitive functioning. The first one is given by the number of correct responses in a simple *math* skills test (from 0 to 4). The second one measures the participants' tendency to *reflect* on their first intuition (i.e., their cognitive style, intuitive vs. reflective) and is given by the number of correct answers (from 0 to 3) in the Cognitive Reflection Test (Frederick, 2005). Cognitive skills and cognitive styles have been previously related to both social behaviors (Burks et al. 2009; Corgnet et al., 2015, 2016; Al-Ubaydli et al., 2016; Cabrales et al., 2017; Capraro et al., 2017) and 2D:4D (Brañas-Garza and Rustichini, 2011; Bosch-Domènech et al., 2014; Cueva et al., 2017) and thus represent potential confounding factors.

Finally, our battery of controls includes three measures for participants' *risk attitudes* obtained from a series of binary decisions involving (hypothetical) monetary lotteries. Risk attitudes may correlate with both social behavior (Bohnet and Zeckhauser, 2004; Corgnet et al., 2016) and 2D:4D (e.g. Brañas-Garza and Rustichini, 2011; Brañas-Garza et al., 2018).

Econometric analysis

We first run a series of regression models. Our five social behavior measures (*DG offer*, *UG offer*, *UG mao*, *TG trust,* and *TG reciprocity*) are regressed on 2D:4D and 2D:4D-squared (*2D:4D-sq*). Additionally, since 2D:4D is sexually dimorphic, the relation between 2D:4D and behavioral traits is often gender-specific (Auyeung et al., 2009; Brañas-Garza and Rustichini, 2011), the adherence to sharing rules may differ across men and women (Croson and Gneezy, 2009; Espinosa and Kovářík, 2015), and testosterone affects men and women asymmetrically (Zethraeus et al., 2009; Eisenegger et al., 2010), we use a male dummy to control for gender and the interaction between gender and either 2D:4D or 2D:4D-squared. The regressions are conducted both with and without other control variables and for both the left- and right-hand 2D:4D. The control variables are *order effects*, *age*, *income*, *life satisfaction*, *social capital*, *math*, *reflection*, and *risk attitudes*. We use OLS regressions for *DG offer*, *UG offer,* and *UG mao*, and logistic regressions for *TG trust* and *TG reciprocity*.

The analysis was performed using Stata/SE 15.1 (StataCorp).

Ethics Statement

All participants were informed about the content of the experiment before they participated and provided written consent. Besides, their anonymity was always preserved (in agreement with the Spanish Law 15/1999 for Personal Data Protection) by assigning them a random numerical code, which would identify them in the system. No association was ever made between their real names and the results. As it is standard in socio-economic experiments, no ethic concerns are involved other than preserving the anonymity of participants. This procedure was checked and approved by the Vice dean of Research of the School of Economics of the University of Granada, the institution hosting the experiment.

RESULTS

Tables 1 – 5 report the estimates of a series of models in which we regress the behavior in a particular role in a particular game on all the combinations of 2D:4D, 2D:4D-squared, and a gender dummy (including interactions of the two former measures with the latter). The models are conducted both with and without control variables and for the left and right hands separately.

This exercise provides a clear message: 2D:4D is not systematically related to the subjects' behavior in any economic game under scrutiny. Independently of the dependent variable and the model specification, in a total of 40 regressions, there does not appear to be any single significant effect of 2D:4D at less than 5% level. The very few effects which are significant at the 10% level disappear if we either include additional control variables and/or adjust for multiple comparisons.

These findings reveal that 2D:4D is not systematically related to behavior in our data and that the effects do not depend on gender. That is, the null results hold for both males and females. Since the preformed multiple comparison procedures only corroborate the null findings from Tables 1 - 5, we do not report them here.

DISCUSSION

This article contributes to the recent literature analyzing the link between prenatal exposure to testosterone and estrogen, proxied by the second-to-fourth digit ratio (2D:4D) and prosocial behavior in economic games. We investigate this question using three canonical two-person games—the Dictator Game, the Ultimatum Game, and the Trust Game—in the lab with real monetary incentives.

Our experimental set up thus comprises five different dimensions of social behavior: generosity, bargaining, fairness, trust and reciprocity. Subjects faced games in rrandom order. It is important to remark that our study uses a large sample of Caucasian participants (*n*=560) with enough power to find a small effect size (specifically, r = 0.12) with 80% power and α = 0.05.

For both males and females, our results show no robust association between right- or left-hand 2D:4D and generosity, bargaining, or trust-related behaviors in any of the 40 regressions conducted. We conclude therefore that there is no direct correlation between 2D:4D and social behavior in economic games. These results are in line with the null findings in a recent study by Parslow et al. (2018), who relate the Dictator Game giving to 2D:4D in a sample of 330 Swedish women (exactly the same number of women as in our sample).

How can we reconcile the differing findings in the literature analyzing the association between 2D:4D and prosocial behavior? It has been argued more generally that—similarly to its circulating counterpart (Mazur and Booth, 1998; Eisenegger et al., 2011)—prenatal testosterone can be understood as a marker for social status (Millet, 2011). The evidence indeed suggests that the association between 2D:4D and other traits is moderated by the context and its relation to status attainment. Low 2D:4D (reflecting *high* testosterone exposure) robustly predicts aggressive or retaliation behavior only if status is at stake or if aggression is provoked (Millet and Dewitte, 2007; Ronay and Galinsky, 2011), while many inconsistencies arise in neutral settings (Millet, 2011; Ryckmans et al., 2015). Furthermore, it seems that this association is more robust using real-life behaviors and outcomes, compared to hypothetical and lab environments (see Millet and Buehler, 2018, for an extensive discussion and review of the evidence). Similarly, Brañas-Garza et al. (2018) document a negative correlation between risk taking and 2D:4D only if the elicitation of risk attitudes is incentivized—and thus potentially relevant for status attainment—but not in a hypothetical task. Millet and Buehler (2018) provide a direct test of the moderating effect of a status-related framing and find strong evidence supporting this hypothesis. These examples are in line with the status- or dominance-related interpretation of the 2D:4D-behavior linkage (Millet, 2011). This interpretation brings the argument that fetal testosterone mainly manifests itself through enhancing the sensitivity to its circulating counterpart, supported by the observation that administered testosterone only affects low 2D:4D individuals (Buskens et al., 2016; Chen et al., 2016; see also Millet and Buehler, 2018). The role of circulating testosterone in status-related situations is widely documented (e.g. Burnham, 2007; Zak et al., 2009; Eisenegger et al., 2011).

The above discussion might also explain the differing findings across studies analyzing prosocial behavior: prosocial behavior might be affected by contextual variables similarly and not controlling for the context might generate omitted-variable issues (Millet, 2011). In our neutral setting without priming status, dominance, or any competition but in which all tasks are incentivized, neither (pro)sociality nor selfishness is *ex ante* status-enhancing and we may expect—and find—little relation between 2D:4D and behavior. This conclusion notwithstanding, these arguments clearly point to the need of exploring potential interactions of 2D:4D with contextual factors in future research.

Table 1. DG offer as a function of 2D:4D

RIGHT HAND

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2D:4D	7.038*	5.717	-177.111	-121.709	3.197	1.927	-251.985	-216.667
	(0.056)	(0.120)	(0.208)	(0.387)	(0.462)	(0.664)	(0.143)	(0.202)
Male	0.070	0.005	0.058	-0.005	-9.046	-8.914	-37.451	-62.821
	(0.812)	(0.988)	(0.844)	(0.987)	(0.229)	(0.247)	(0.787)	(0.671)
$2D{:}4D^2$			94.754	65.543			130.738	111.933
			(0.189)	(0.364)			(0.138)	(0.199)
2D:4D *Male					9.449	9.248	65.609	118.630
					(0.220)	(0.240)	(0.818)	(0.697)
$2D{:}4D^2$*Male							-27.678	-55.411
							(0.850)	(0.723)
Controls	no	yes	no	yes	no	yes	no	yes
Observations	560	560	560	560	560	560	560	560

LEFT HAND

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2D:4D	7.504*	5.784	-97.719	-145.191	1.579	0.294	-125.801	-185.837
	(0.084)	(0.166)	(0.642)	(0.497)	(0.759)	(0.953)	(0.622)	(0.472)
Male	0.062	-0.002	0.061	-0.006	-14.252	-13.185	16.890	0.940
	(0.833)	(0.995)	(0.835)	(0.986)	(0.106)	(0.139)	(0.931)	(0.996)
$2D{:}4D^2$			54.083	77.589			65.308	95.412
			(0.616)	(0.479)			(0.619)	(0.473)
2D:4D *Male					14.769	13.606	-50.361	-16.761
					(0.101)	(0.134)	(0.900)	(0.969)
$2D{:}4D^2$*Male							34.008	16.272
							(0.868)	(0.941)
Controls	no	yes	no	yes	no	yes	no	yes
Observations	560	560	560	560	560	560	560	560

Estimates of OLS regressions (p-values). *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 2. UG offer as a function of 2D:4D

RIGHT HAND

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2D:4D	-0.795	-0.754	119.560	99.483	-19.49	-1.417	66.154	48.608
	(0.685)	(0.706)	(0.103)	(0.1429	(0.448)	(0.577)	(0.521)	(0.619)
Male	0.095	0.111	0.103	0.118	-2.643	-1.464	-59.721	-61.474
	(0.529)	(0.531)	(0.496)	(0.503)	(0.494)	(0.701)	(0.420)	(0.397)
2D:4D^2			-61.929	-51.559			-34.891	-25.629
			(0.100)	(0.138)			(0.508)	(0.607)
2D:4D *Male					2.838	1.633	121.941	126.595
					(0.475)	(0.675)	(0.425)	(0.398)
2D:4D^2*Male							-62.049	-64.970
							(0.430)	(0.399)
Controls	no	yes	no	yes	no	yes	no	yes
Observations	560	560	560	560	560	560	560	560

LEFT HAND

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2D:4D	-1.016	-0.903	40.589	31.333	-3.306	-3.009	-45.680	-62.339
	(0.655)	(0.703)	(0.652)	(0.742)	(0.205)	(0.244)	(0.569)	(0.492)
Male	0.094	0.110	0.094	0.111	-5.440	-4.965	-91.337	-99.727
	(0.531)	(0.535)	(0.529)	(0.533)	(0.251)	(0.297)	(0.357)	(0.375)
2D:4D^2			-21.384	-16.570			21.725	30.412
			(0.643)	(0.733)			(0.598)	(0.513)
2D:4D *Male					5.709	5.236	182.295	200.627
					(0.240)	(0.281)	(0.370)	(0.387)
2D:4D^2*Male							-91.274	-100.610
							(0.384)	(0.400)
Controls	no	yes	no	yes	no	yes	no	yes
Observations	560	560	560	560	560	560	560	560

Estimates of OLS regressions (p-values). *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 3. UG MAO as a function of 2D:4D

RIGHT HAND

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2D:4D	-0.525	-1.804	-104.860	-37.509	-1.910	-3.282	-79.306	-44.706
	(0.890)	(0.621)	(0.477)	(0.792)	(0.673)	(0.455)	(0.609)	(0.775)
Male	-0.243	0.033	-0.250	0.030	-3.531	-3.480	54.744	11.729
	(0.367)	(0.908)	(0.352)	(0.916)	(0.647)	(0.636)	(0.730)	(0.949)
2D:4D^2			53.686	18.366			31.678	21.218
			(0.479)	(0.802)			(0.618)	(0.791)
2D:4D *Male					3.408	3.641	-118.279	-28.341
					(0.670)	(0.633)	(0.719)	(0.930)
2D:4D^2*Male							63.439	16.785
							(0.708)	(0.919)
Controls	no	yes	no	yes	no	yes	no	yes
Observations	560	560	560	560	560	560	560	560

LEFT HAND

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2D:4D	0.389	-1.110	-317.134*	-185.407	2.419	0.730	-282.032	-166.678
	(0.920)	(0.773)	(0.075)	(0.302)	(0.617)	(0.880)	(0.197)	(0.470)
Male	-0.231	0.043	-0.234	0.039	4.673	4.477	134.006	11.825
	(0.391)	(0.880)	(0.384)	(0.891)	(0.551)	(0.554)	(0.851)	(0.949)
2D:4D^2			163.201*	94.759			145.838	85.843
			(0.076)	(0.306)			(0.195)	(0.470)
2D:4D *Male					-5.060	-4.575	-67.432	-20.782
					(0.531)	(0.558)	(0.857)	(0.957)
2D:4D^2*Male							33.088	8.886
							(0.864)	(0.964)
Controls	no	yes	no	yes	no	yes	no	yes
Observations	560	560	560	560	560	560	560	560

Estimates of OLS regressions (p-values). *** p<0.01, ** p<0.05, * p<0.1

Table 4. TG trust as a function of 2D:4D

RIGHT HAND

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2D:4D	1.463	0.878	-38.939	-31.118	1.961	1.489	-55.377	-50.114
	(0.594)	(0.760)	(0.733)	(0.782)	(0.573)	(0.679)	(0.692)	(0.721)
Male	0.287	0.124	0.284	0.122	1.544	1.662	-25.762	-32.615
	(0.136)	(0.559)	(0.140)	(0.566)	(0.777)	(0.774)	(0.827)	(0.780)
$2D{:}4D^2$			20.799	16.465			29.405	26.431
			(0.723)	(0.776)			(0.682)	(0.713)
2D:4D *Male					-1.304	-1.596	54.763	68.952
					(0.818)	(0.790)	(0.821)	(0.774)
$2D{:}4D^2$*Male							-28.748	-36.259
							(0.818)	(0.770)
Controls	no	yes	no	yes	no	yes	no	Yes
Observations	560	560	560	560	560	560	560	560

LEFT HAND

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2D:4D	-1.627	-1.627	172.769	182.877	0.879	-0.011	295.392*	292.150*
	(0.597)	(0.597)	(0.160)	(0.147)	(0.818)	(0.998)	(0.055)	(0.061)
Male	0.092	0.092	0.263	0.092	4.292	4.265	154.786	137.625
	(0.665)	(0.665)	(0.173)	(0.666)	(0.464)	(0.494)	(0.233)	(0.320)
$2D{:}4D^2$			-89.122	-94.812			-151.029*	-149.861*
			(0.158)	(0.143)			(0.055)	(0.061)
2D:4D *Male					-4.158	-4.307	-313.274	-278.120
					(0.491)	(0.502)	(0.241)	(0.328)
$2D{:}4D^2$*Male							158.553	140.384
							(0.248)	(0.336)
Controls	no	yes	no	yes	no	yes	no	yes
Observations	560	560	560	560	560	560	560	560

Estimates of logistic regressions (p-values). *** p<0.01, ** p<0.05, * p<0.1

Table 5. TG reciprocity as a function of 2D:4D

RIGHT HAND

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2D:4D	1.093	1.696	-153.481	-178.953	-3.042	-2.541	-204.001	-253.7
	(0.707)	(0.588)	(0.220)	(0.149)	(0.416)	(0.529)	(0.218)	(0.153
Male	0.197	0.052	0.187	0.035	-10.587*	-10.932*	48.031	59.75
	(0.355)	(0.828)	(0.378)	(0.884)	(0.070)	(0.072)	(0.705)	(0.663
2D:4D^2			79.600	92.967			102.783	128.31
			(0.216)	(0.146)			(0.224)	(0.156
2D:4D *Male					11.204*	11.417*	-114.918	-141.7
					(0.065)	(0.070)	(0.661)	(0.618
2D:4D^2*Male							67.768	82.68
							(0.616)	(0.574
Controls	no	yes	no	yes	no	yes	no	yes
Observations	560	560	560	560	560	560	560	560

LEFT HAND

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2D:4D	2.105	2.182	-126.253	-156.532	-0.573	-0.893	-292.803	-355.02
	(0.501)	(0.527)	(0.459)	(0.392)	(0.881)	(0.8349	(0.240)	(0.180)
Male	0.206	0.055	0.206	0.054	-6.833	-8.055	-163.398	-193.79
	(0.336)	(0.821)	(0.337)	(0.823)	(0.287)	(0.240)	(0.321)	(0.273)
2D:4D^2			66.049	81.692			141.745	181.47
			(0.452)	(0.386)			(0.243)	(0.183)
2D:4D *Male					7.279	8.392	328.816	389.68
					(0.273)	(0.237)	(0.332)	(0.285)
2D:4D^2*Male							-164.920	-195.48
							(0.344)	(0.298)
Controls	no	yes	no	yes	no	yes	no	yes
Observations	560	560	560	560	560	560	560	560

Estimates of logistic regressions (p-values). *** p<0.01, ** p<0.05, * p<0.1

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