Digit ratio (2D:4D) and prosocial behavior in economic games: No direct correlation with generosity, bargaining, or trust-related behaviors

Pablo Brañas-Garza[1+], Antonio M. Espín[2], Teresa García-Muñoz[2]& Jaromír Kovářík[3,4]

[1] *LoyolaBehLAB*, Universidad Loyola Andalucía, [2]Universidad de Granada,
[3]Universidad del País Vasco (UPV/EHU), [4]CERGE-EI

+Corresponding author: Pablo Brañas-Garza, branasgarza@gmail.com

ABSTRACT (149 words)

Prenatal exposure to sex hormones exerts organizational effects on the brain which have observable behavioral correlates in adult life. There are reasons to expect that social behaviors—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 analyze 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. Moreover, no differences in behavior were found according to sex. We conclude that there is no direct correlation between 2D:4D and these social behaviors.

Keywords: social behavior; 2D:4D; digit ratio; testosterone; fairness

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INTRODUCTION

Humans display various social behaviors, such as generosity, fairness, trust, and reciprocity, each with its own social and bio-psychological underpinnings (1-4). However, while our species shows distinctive behavioral patterns in the social domain compared to other taxa, there exists large individual heterogeneity. For example, some people are more generous, trustful, or reciprocal than others. Although we know that some of the variation emanates from cultural differences (5-7), considerable heterogeneity still emerges within cultural groups. This study analyzes the biological roots of individual differences in generosity, bargaining, and trust-related behaviors. Indeed, many studies—without relying on any particular biological trait—suggest that social behavior is heritable or genetically determined to some extent (8, 9, 2). Similarly, different biological and genetic factors at certain times of development might determine predispositions toward different social behaviors (11-13). The amount of hormones individuals are exposed to during prenatal development could be one such factor (14-16). Fetal exposure to hormones such as androgens and cortisol is known to exert organizational effects on the human body and brain which may influence behavior later in life (17-20). Since hormonal levels are strongly influenced by genetics (21, 22), this may be a channel for the intergenerational transmission of behavior.

Concerning social behavior, sex hormones and androgens in particular have attracted considerable attention. Numerous studies have examined the behavioral correlates of circulating (endogenous or administered) testosterone levels (23-29). 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 *in utero* exposure to testosterone compared to estradiol (Lutchmaya et al., 2004). Although direct evidence for the 2D:4D-fetal sex hormones link only exists for mice (31), rats (32, 33), and birds (34), there is large indirect evidence and the ratio is commonly accepted as a proxy of fetal hormone exposure (also) in humans (see 35-36 for evidence and arguments against this interpretation). 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 (37, 38). Many studies, some using large samples, have analyzed the association between 2D:4D and diverse aspects of social involvement and interactions, including status seeking (39), social network positioning (40), and managerial ability (41).

Regarding the economic games designed to elicit (pro)social preferences, the literature is inconclusive as to whether and how 2D:4D predicts subjects' social behavior. Some studies report negative effects (42, 43), whereas others indicate positive effects (44-48) on prosocial behaviors such as generosity or cooperation. Null and non-linear (mostly quadratic) relationships have also been frequently reported (49-56). 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 (46) observed that lower 2D:4D increases or decreases rejection rates (i.e., punishment) in the Ultimatum Game (UG) depending on whether subjects are in a neutral or sex-related context, respectively, whereas Millet and Dewitte (49) detected a negative or positive association between 2D:4D and generosity in Dictator Games (DG) depending on whether or not participants are primed with aggression cues.

In sum, the existing evidence provides no specific hypothesis regarding how prenatal sex hormone exposure (as proxied by 2D:4D) organizes (pro)social behavior in economic games. Note that many of these papers are based on hypothetical decisions without monetary consequences.

Three features of this study distinguish it from previous research. First, we use a large sample size consisting of 560 individuals that permits high statistical power.

Second, we elicit five dimensions of social behavior using three economic games with real monetary stakes. Our participants decided as Dictators in a DG (see 53, 57) measuring generosity, as both Proposers and Responders in the UG (see 58) measuring bargaining and punishment behavior, and as both Trustors and Trustees in the Trust Game (TG) (see 59) measuring trust and reciprocity (see Methods). Previous studies suggest there might be sex differences: women are more generous (57), males trust more, but women are more trustworthy (60). Evidence on sex differences in bargaining and punishment is mixed and there is some indication that the counterpart's sex might play a role in UG behavior (61, 62). Thus, sexually dimorphic (biological) traits such as prenatal hormone exposure may potentially predict behavior in these games.

Finally, our dataset enables controlling for a number of potential confounding factors, including cognitive reflection (63, 64) or risk preferences (65, 66) (see Supplementary Materials [SM]).

METHODS

Participants and protocol

The experiment was conducted in October 2011 at the EGEO Lab of the University of Granada. The sample comprised 560 Caucasian subjects (330 females; age: mean±SD=17.97±1.82). Participants were first asked to complete the socio-demographic and personality characteristics section, including self-reported life satisfaction, risk preferences, and social capital. In addition, the survey contained a math test with four simple questions. After the survey, the subjects played the economic games in random order. Finally, they completed the Cognitive Reflection Test (67). These variables are used as controls in the regression analysis. Below, we briefly explain the elicitation and structure of our three main variable types. More details about the procedures are reported in the SM.

After completing the tasks, a research assistant scanned both hands of all the participants using a high-resolution scanner. The same researcher measured the finger lengths twice from the images using Photoshop. The two resulting 2D:4D measurements were averaged to obtain a single 2D:4D ratio value for each hand. As expected, the left-hand and right-hand 2D:4Ds were positively correlated (r=0.67, $p<0.001$ for males; r=0.71, $p<0.001$ for females; Pearson correlation) and males displayed lower 2D:4D than females (right-hand means±SD: $2D{:}4D_M$=0.960±0.033,

$2D:4D_F=0.972\pm0.033$, *p<0.001*; left-hand means: $2D:4D_M=0.965\pm0.032$, $2D:4D_F=0.976\pm0.032$, *p<0.001*; *t*-test; see SM).

Social behavior measurement: Economic games

Our experiment consisted of three canonical two-person games: the DG, UG, and TG. As is standard in economic lab experiments, participants made their decisions individually on their computers and never learnt the identity of the person they were (randomly) matched with.

In the DG, the Dictator had to divide €20 between herself and another anonymous participant, the Receiver, who had to accept the offer. The amount donated to the other participant (*DG offer*) was our measure of generosity.

In the UG (58; see Figure SM1), the Proposer proposed a division of €20 between herself and another anonymous participant, the Responder, who—unlike the DG—could either accept or reject the proposal. If the Responder 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 was our measure of the Proposers' bargaining behavior. For the role of Responder, we used the minimum acceptable offer (*mao*), typically interpreted as indicative of the Responder's willingness to punish (unfair) Proposers at a personal cost (1, 5, 68, 23, 69).

We employed a binary version of TG (70). Player 1, the Trustor, had to decide whether to give the Trustee €10 or €0. If she gave €0, the Trustor earned €10 and the Trustee nothing; if she gave €10, the Trustee received 4×€10=€40. In this case, the Trustee had to decide whether to return €22 and keep €18 for herself (that is, be trustworthy) or keep all €40 without returning anything. The Trustor's decision thus measures trust, whereas the Trustee's decision measures reciprocity (see Figure SM1).

Decisions were not hypothetical. Participants' payoffs were computed according to their decisions in the games and those of a randomly matched participant. One of every ten participants was randomly selected for payment, and the final payoff was determined by a randomly selected role (from the six possible roles, including as Receiver in the DG, which is passive). Previous studies have shown that this payment method yields reliable data in economic experiments (see 71 and 72). The average earnings of those selected for payment, including those winning €0 (11.43%), were €10.43. Descriptive statistics and bivariate correlations of the game outcomes and variables are shown in Tables SM1 and SM2.

RESULTS

Tables SM3–SM7 report the estimates of a series of models in which we regress the behavior in a particular role in a particular game on the combinations of 2D:4D, 2D:4D-squared (to analyze non-linear, quadratic relationships; 52, 66), and a gender dummy variable (including interactions). The models were conducted with and without control variables and for the left and right hands separately.

Our analyses give a clear message: 2D:4D is not systematically related to the subjects' behavior in any game. Independently of the outcome variable and model specification, in a total of 40 regressions, 2D:4D did not have a single effect at the 5% significance level. The few significant effects at the 10% level disappear when including additional control variables and/or adjusting for multiple comparisons. Additionally, the gender dummy variable is never significant (*t*-tests and proportion tests comparing males and females' behavior always yield $p>0.16$; see Table SM2).

Hence, 2D:4D is not systematically related to behavior in our data and the effects do not depend on gender. Since multiple comparison correction only corroborates the null findings from Tables SM3–SM7, they are not reported.

We also performed a factor analysis as a robustness check to exclude the possibility of measurement errors distorting our estimates (56, 73). As in previous studies (74, 56), our analysis supports the existence of an underlying factor common to *DG offer*, *UG offer*, *TG trust*, and *TG reciprocity*, but not *UG mao*. However, confirmatory latent variable analysis using structural equation modeling fails to detect any association between 2D:4D and the latent "prosociality" obtained in the eight model specifications estimated for each hand (results available upon request).

DISCUSSION

This article contributes to the literature analyzing the link between prenatal exposure to testosterone/estrogen and prosocial behavior in economic games. We investigate this question using three canonical two-person games—DG, UG, and TG—with real monetary incentives.

Our experimental setup comprises five different dimensions of social behavior: generosity, bargaining, punishment, trust, and reciprocity. It is worth remarking that we use 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, we find no robust association between right/left-hand 2D:4D and generosity, bargaining, or trust-related behaviors in any of the 40 regressions. These results are in line with recent evidence in Candelo and Eckel (54) and Parslow et al. (55), who analyze DG giving in a sample of 115 African-Americans and 330 Swedish women, respectively. In a larger sample using a larger number of incentivized decisions, our results corroborate the lack of a direct relationship. We also fail to find significant sex differences in social behavior, in contrast to previous research (60, 57). It might be that a significant 2D:4D-prosociality relationship is observed in samples where there are sex differences, which is not our case. Future work should tackle this question.

How can we reconcile the different findings in the literature on the association between 2D:4D and (pro)social behavior? It has been argued that—similarly to its circulating counterpart (75; 27)—prenatal testosterone can be understood as a marker for social status (76). 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 aggression is provoked (45, 47), while many inconsistencies arise in neutral settings (76, 77). Furthermore, the association is more robust using real-life behaviors and outcomes than hypothetical and lab environments (78). Similarly, Brañas-Garza et al. (66) reported a 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 (78) provided a direct test of the moderating effect of status-related framing and found strong evidence supporting this hypothesis. These examples are in line with the status- or dominance-related interpretation of the 2D:4D-behavior linkage (76). According to this interpretation, 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 (79, 80; see also 78). The role of circulating testosterone in status-related situations is widely documented (23, 24, 28).

The above discussion might also explain the diverse findings on social behavior: social behavior might be affected by contextual variables similarly and not controlling for the context might generate omitted-variable issues (76). In our neutral setting without priming status, dominance, or competition but in which all tasks are incentivized, neither (pro)sociality nor selfishness is *ex ante* status-enhancing and we may expect—and find—no systematic relation between 2D:4D and behavior. This is in line with recent arguments that 2D:4D might be a biomarker for (prenatal and adult) sex hormones solely in challenging situations (81). The UG *mao* case is worth noting. Previous studies suggest that relative standing or status, and not fairness *per se*, is an important concern in UG rejections (82-84). However, other studies have found evidence that both "prosocial" and "antisocial" punishers coexist in the UG. High *mao* might then emanate from a desire either to impose fairness or maintain one's relative standing (69), beyond other motives (85). Thus, rejections in the UG may stem from multiple motivations. Future research should explore these possibilities.

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Digit ratio (2D:4D) and prosocial behavior in economic games: No direct correlation with generosity, bargaining or trust-related behaviors

Pablo Brañas-Garza, Antonio M. Espín, Teresa García-Muñoz & Jaromír Kovářík

Supplementary materials

Details on the protocol and analysis and Tables SM1-7

1) Details on the protocol and analysis

2D:4D measurement

At the end of each session, both the left and right hands of all the participants were scanned 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) = 0.957, $p<0.001$, left hand: ICC = 0.944, $p<0.001$) 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, $p<0.001$ for males; r =0.71, p < 0.001 for females; Pearson correlation) and males displayed lower 2D:4D than females (right-hand means [SD]: $2D{:}4D_M$ =0.960 [0.033], $2D{:}4D_F$ =0.972 [0.033], $p<0.001$; left-hand means: $2D{:}4D_M$ =0.965 [0.032], $2D{:}4D_F$ =0.976 [0.032], p<0.001; t-test).

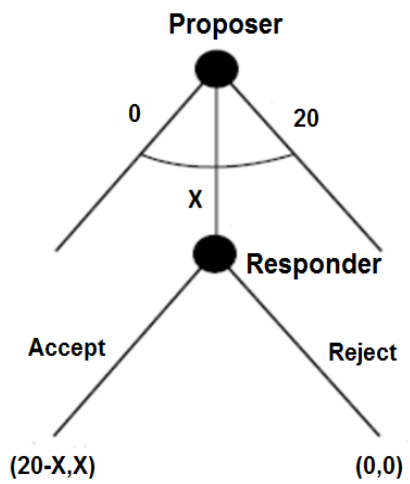
Social behavior measurement - Economic games

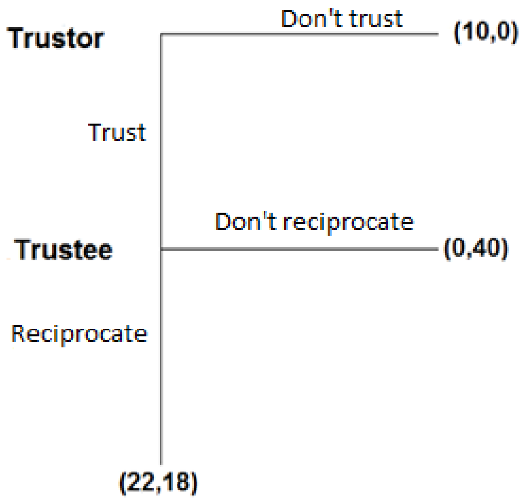
Our experiment consists of three canonical two-person games: the Dictator Game (hereafter ‘DG’), the Ultimatum Game (UG), and the Trust Game (TG). The games were faced by each participant in random order and all participants played both roles in each game. For each decision, participants would be matched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

In the DG, one player, the Dictator, had to divide €20 between herself and another anonymous participant, the Receiver, who could not but accept the offer. In our experiment, subjects were only allowed to propose the split in €2 increments. We employ the amount of money donated to the other participant (*DG offer*) as a measure of generosity. Although the role of Receiver is passive in the DG, to make sure that Dictators' decisions affect others, the role of Receiver could have been selected for payment. That is, participants made five decisions but there existed six different roles for payment (and this was carefully explained to the participants).

In the UG (Güth et al., 1982; see Figure SM1), 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 (hereafter '*mao'*)—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 (unfair) Proposer at a personal cost (e.g. Fehr and Fischbacher, 2003; Henrich et al., 2005; Brañas-Garza et al., 2006).

Figure SM1. 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; Figure SM1) 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.

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 reflection 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; 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.

Social capital is measured using the so-called "trust question" from the General Social Survey and is included to control for the social environment where the participant typically interacts in daily life, i.e. whether people around can in general be trusted or not (binary variable): "*Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?*"

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*; to test for non-linear relationships, e.g. Brañas-Garza et al., 2013). Additionally, since 2D:4D is sexually dimorphic, the relation between 2D:4D and behavioral traits is often gender-specific (e.g 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 dummy variable 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 Ordinary Least Squares 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).

2) Supplementary Tables

Table SM1. Descriptive statistics of 2D:4D, game outcomes and control variables

Variables	Mean or percentage	SD	Min	Max
Right 2D:4D	0.97	0.03	0.87	1.09
Left 2D:4D	0.97	0.03	0.88	1.07
Game outcomes				
DG offer	8.26	3.41	0	20
UG offer	9.56	1.67	0	20
UG mao	6.00	3.07	0	10
TG trust (%)	69.29		0	1
TG reciprocity (%)	79.11		0	1
Control variables				
Male (%)	41.07		0	1
Age	17.97	1.82	18	29
Household income	2.13	0.75	0	4
Life satisfaction	5.68	1.05	1	7
Social capital (%)	21.96		0	1
Math	2.46	0.81	0	4
Reflect (CRT)	0.72	0.95	0	3
Risk 1 (%)	9.82		0	1
Risk 2 (%)	33.04		0	1
Risk 3 (%)	11.96		0	1
Sample size	560			

Note: Percentages of cases '=1' are displayed for binary variables (0/1)

Table SM2. Bivariate relationships between all variables (Pearson, t-test and p-test)

	DG off	UG offer	UG MAO	TG trust	TG Rec	R 2D:4D	L 2D:4D
UG offer	0.28***						
UG mao	-0.03	0.09**					
TG trust	1.71*	-0.28	-1.79*				
TG reciprocity	5.39***	1.68*	-0.20	3.62***			
Right 2D:4D	0.06	-0.02	0.00	0.25	0.18		
Left 2D:4D	0.07	-0.02	0.01	-0.47	0.49	0.70***	
Male	-0.07	0.71	-0.89	1.42	0.87	-4.50***	-4.00***
Age	0.02	0.02	-0.03	1.18	0.08	0.06	0.05
Household income	-0.00	-0.01	-0.07	0.67	-0.35	0.00	-0.03
Life satisfaction	-0.01	-0.02	0.03	0.75	1.88*	-0.03	0.01
Social capital	1.37	1.32	-1.26	1.06	-0.83	0.97	1.74*
Math	-0.06	0.03	-0.06	0.15	2.35**	-0.02	0.01
Reflect (CRT)	-0.04	0.03	-0.06	0.30	1.29	-0.16	-0.13
Risk 1	1.65	-0.81	0.74	2.43**	0.87	1.31	1.43
Risk 2	-0.71	-1.70*	-0.76	0.74	-1.62	0.54	0.59
Risk 3	1.48	-1.15	-0.68	2.14**	-1.28	0.03	-0.32
	Male	Age	Household income	Social capital	Math	Life satisfaction	Reflect (CRT)
Age	3.18***						
Household income	1.19	-0.11***					
Social capital	3.42***	2.36**	-0.85				
Math	4.45***	0.03	0.00	1.39			
Life satisfaction	2.67***	-0.15***	0.11**	2.55**	0.09**		
Reflect (CRT)	4.61***	-0.01	-0.06	0.78	0.19***	0.02	
Risk 1	2.72***	-0.30	-0.38	1.00	1.04	1.32	1.10
Risk 2	2.19**	-2.51**	1.60	1.82*	2.09**	0.65	0.14
Risk 3	1.72*	-1.18	1.33	1.98**	0.24	2.39**	-0.05
	Risk 1	Risk 2					
Risk 2	4.78***						
Risk 3	1.93*	3.28***					

Note: Pearson correlation coefficients are displayed for the relationship between two continuous variables; for the relationship between a continuous and a binary variable, we report the t-statistic from t-tests (negative sign: 0>1, positive sign: 1>0; see Table SM1); for the relationship between two binary variables, we report the z-statistic from proportion tests (negative sign: negative relationship, positive sign: positive relationship). ***p<0.01, **p<0.05, *p<0.1

Table SM3. 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

Note: Eight different models are estimated for the 2D:4D of each hand. Models labeled with even numbers include the following control variables: order effects, age, income, life satisfaction, social capital, math, reflection, and risk attitudes. Estimates of OLS regressions (p-values). *** p<0.01, ** p<0.05, * p<0.1

Table SM4. 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

Note: Eight different models are estimated for the 2D:4D of each hand. Models labeled with even numbers include the following control variables: order effects, age, income, life satisfaction, social capital, math, reflection, and risk attitudes. Estimates of OLS regressions (p-values). *** p<0.01, ** p<0.05, * p<0.1

Table SM5. 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

Note: Eight different models are estimated for the 2D:4D of each hand. Models labeled with even numbers include the following control variables: order effects, age, income, life satisfaction, social capital, math, reflection, and risk attitudes. Estimates of OLS regressions (p-values). *** p<0.01, ** p<0.05, * p<0.1

Table SM6. 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	-0.690	-0.627	172.769	182.877	0.879	-0.011	295.392*	292.150*
	(0.817)	(0.597)	(0.160)	(0.147)	(0.818)	(0.998)	(0.055)	(0.061)
Male	0.260	0.092	0.263	0.092	4.292	4.265	154.786	137.625
	(0.176)	(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

Note: Eight different models are estimated for the 2D:4D of each hand. Models labeled with even numbers include the following control variables: order effects, age, income, life satisfaction, social capital, math, reflection, and risk attitudes. Estimates of logistic regressions (p-values). *** p<0.01, ** p<0.05, * p<0.1

Table SM7. 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	-253.795
	(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	59.753
	(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	128.311
			(0.216)	(0.146)			(0.224)	(0.156)
2D:4D *Male					11.204*	11.417*	-114.918	-141.702
					(0.065)	(0.070)	(0.661)	(0.618)
2D:4D^2*Male							67.768	82.686
							(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	-355.024
	(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	-193.792
	(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	181.472
			(0.452)	(0.386)			(0.243)	(0.183)
2D:4D *Male					7.279	8.392	328.816	389.684
					(0.273)	(0.237)	(0.332)	(0.285)
2D:4D^2*Male							-164.920	-195.486
							(0.344)	(0.298)
Controls	no	yes	no	yes	no	yes	no	yes
Observations	560	560	560	560	560	560	560	560

Note: Eight different models are estimated for the 2D:4D of each hand. Models labeled with even numbers include the following control variables: order effects, age, income, life satisfaction, social capital, math, reflection, and risk attitudes. Estimates of logistic regressions (p-values). *** $p<0.01$, ** $p<0.05$, * $p<0.1$

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