Supplementary Information Appendix for:

Prenatal Sex Hormones (2D:4D Digit Ratio) and Social Integration

Jaromír Kovářík*, Pablo Brañas-Garza, Michael W. Davidson †, Dotan A. Haim †, Shannon Carcelli †, and James H. Fowler ‡**

**University of the Basque Country, Bilbao, Spain and CERGE-EI, Charles University & the Economics Institute of the Academy of Sciences of the Czech Republic, Prague, Czech Republic.*

***Middlesex University, London, England.*

†*Department of Political Science, University of California, San Diego.*

‡*Medical Genetics Division and Department of Political Science, University of California, San Diego.*

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1 Appendix Introduction

This document provides additional supporting evidence for the methods and results in the main text. It contains eight supplementary tables and four supplementary figures.

2 Ethics Statement

The study was approved by the Ethical Committee of the Universidad de Granada and all subjects provided informed written consent (IC). The IC explains the content of the experiment they will perform and the payoffs attached to their performance. Anonymity was also assured and the Spanish law regarding data protection briefly explained.

3 Subjects

Participants were first-year undergraduate students in economics at the University of Granada. In total, 247 subjects participated in at least one of the sessions but 3 did not report their gender; 178 subjects participated in all measurements. 2 non-Caucasian subjects were excluded to ensure ethnic homogeneity, resulting in a sample of 176 individuals (79 females).

4 Sampling Methods

An undergraduate microeconomics course in academic year 2010-2011 was separated randomly into four groups, outlined in Table 1. To assign students to groups, a computer program was used to randomly select one surname and assign that student and the next few, in ascending or descending order, to a group until that group was filled. The next students were then assigned to the next group until it was filled, and so on. Groups A and B typically studied in adjacent rooms. Students are allowed to sit in on a different session if they so chose. Groups C and D were in the very same rooms. C and D started their classes when A and B ended. Students interacted with each other a lot and took courses in both morning and evening sessions. Those who attrited were not evaluated at the end of the year (June 2011).

5 Social Network Elicitation

Social ties were elicited twice with the same group of undergraduate students: (T1) in the first week of their first academic year in October 2010 and (T2) at the end of the academic year in May 2011. In both 2010 and 2011, all four sections of first year students were visited and students were invited to participate in an economic experiment involving money. The participation was voluntary.

Table 3:

Group	Males	Females	Attrition
A	44	27	16.9 %
B	38	33	9.8%
C	37	22	18.6%
D	63	26	33.3%

Any individual who did not want to participate was allowed to leave the class before each session. Those willing to participate were seated separately, each with enough space to preserve anonymity, and they were provided with written instructions. In particular, we elicited their within-class social ties (without providing any incentives). Each participant was invited to name his friends in the whole first year, but people were instructed to name individuals for whom they knew both surnames. Reference [1] provides further details concerning these sessions.

We did not inform students or professors before-hand that we were going to run an experiment at that day. We came to the class and we asked them to participate in the same room they were in. This negated the possibility that students who did not want to participate in the study would not show up on the day that we took measurements. We offered monetary payments for those who completed the experiments, which involved dictator games, lotteries, etc. Almost all students decided to participate before knowing that we were going to elicit networks.

6 2D:4D measurement

Subjects were invited one by one to an office for the scanning of their both hands. Both hands were scanned with a high-resolution scanner (Canon Slide 90). We measured the lengths of the index and ring digits on both hands from basal crease to the finger tip using Adobe Professional. As opposed to the network elicitation, we only scanned the hands once. However, to ensure the most accurate measurement, a research assistant with no relation to this study measured the ratio from the scanned hands twice. The first measurement was made right after the scanning, while the second was performed 14 months later, in January 2012. For each individual observation in all statistical tests in this study, we use the mean of these two measurements from the right hand. In line with the literature, we eliminated 3 non-Caucasian subjects (only 2 of them participated in the network elicitation though). This leaves us with a total of 202 observations (92 females), from which some did not participated in the network elicitation (see Table 1 in the main text). For left hands, we only have 201 2D:4D's, because one male subject had his left-hand index finger broken in

the past.

In the following, we provide some statistics concerning the 2D:4D in our sample. First, regarding the right hands the linear correlation between the first (second) measurement and the average applied in this study is 0.969 (0.968) and the correlation between the two independent measurements is 0.876. The corresponding figures are 0.958, 0.957, and 0.834 for males and 0.979, 0.977, and 0.912 for females. Testing the equality of any pair of all these measurements either at the sample level or separately for men or women and either using a simple t-test or a non-parametric Wilcoxon rank-sum test always yields an extremely low p-values ($p < 2.2e^{-16}$). The resulting average 2D:4D is 0.951 (SD: 0.032) for men and 0.967 (SD: 0.033) for women. Thus, males have smaller 2D:4D's on average than females ($p < 0.001$ using simple both a two-tailed t-test or a non-parametric Wilcoxon rank-sum test), but the magnitude of the variation within gender is almost identical. In the regression analysis, we thus normalize the variable 2D:4D for men and women separately.

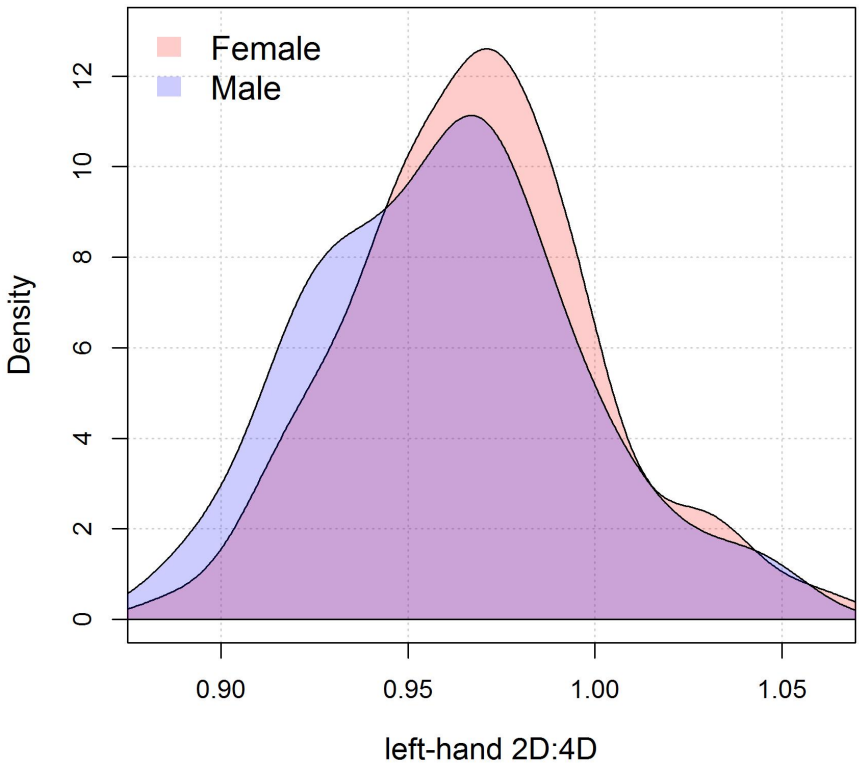
Even though we do not use the left-hand 2D:4D in this study, we summarize it here and relate to the right-hand ratios. For the sake of comparability, we have measured the left-hand 2D:4D from the scanned pictures twice and report the average. The resulting mean left-hand 2D:4D is 0.961 (SD: 0.036) for men and 0.969 (SD: 0.032) for women. The ratio is again higher for women on average, but this time the difference is not statistically significant at conventional 5% ($p = 0.196$ and 0.097 for the same tests as above). Supplementary Figure 1 plots the smoothed histograms of the left-hand 2D:4D for both genders (see Figure 2 in the main text for a comparison with right hands). The linear correlations between the left- and right-hand 2D:4D are 0.657 for the whole sample, 0.658 for men, and 0.646 for women.

7 Figures Demonstrating Censored Distributions

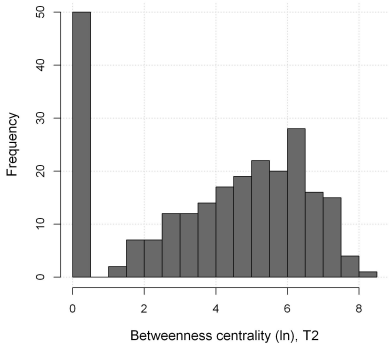
The following three supplementary figures provide a visual illustration of the censored nature of the transitivity and betweenness centrality variables as measures of social integration. As such, these figures provide justification for the use of a tobit model for measuring the relationship between 2D:4D and transitivity and betweenness centrality. Supplementary Figure 2 demonstrates a large accumulation of individuals with zero betweenness (ln). The distribution of transitivity is presented in Figures 3 and 4, with peaks at both zero and one regardless of whether we set observations with less than two connections to zero (Figure 3) or omit them altogether (Figure 4).

8 Robustness Tests

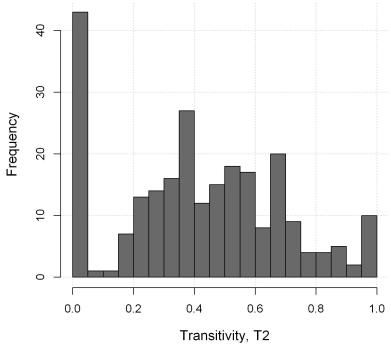
The tables below report several variations of the benchmark models reported in Table 2 of the main text. They are meant to serve as robustness tests to ensure that the results are consistent across model specifications.



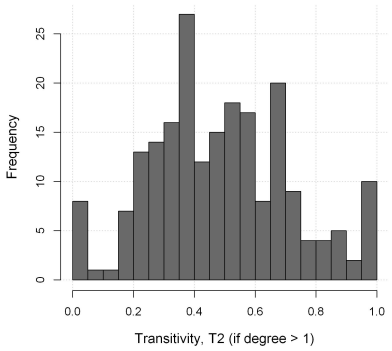
Supplementary Figure 1: The distribution of the left-hand 2D:4D in the sample.



Supplementary Figure 2: The distribution of betweenness centrality at T2 is censored from below by 0



Supplementary Figure 3: The distribution of transitivity at T2 is censored from below by 0 and from above by 1



Supplementary Figure 4: The distribution of transitivity at T2 is censored from below by 0 and from above by 1 even if we only consider individuals with degree larger than 1

Supplementary Tables 2 - 4 show that the estimations in Table 2 in the main text are robust to the estimation technique applied or controlling for local centrality in the estimations corresponding to transitivity and betweenness centrality.

8.1 Controlling for Degree Centrality in Transitivity and Betweenness Models

Supplementary Table 2: Association of 2D:4D with network measures at T2, controlling for local centrality in the regressions corresponding to transitivity and betweenness

	In-degree, T2		Out-degree, T2		Transitivity, T2		Between.(ln), T2	
	Male	Female	Male	Female	Male	Female	Male	Female
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2D:4D	-.045	-.440**	-.141	.033	.064**	-.037*	-.396**	.255
	(.123)	(.178)	(.096)	(.285)	(.023)	(.019)	(.182)	(.275)
Network, T1	.201*	.140	.068	.238	.117	-.027	.061	.090
	(.116)	(.173)	(.159)	(.206)	(.073)	(.033)	(.046)	(.140)
Degree, T2					-.001	.026	.357**	.472**
					(.006)	(.019)	(.060)	(.046)
Constant					.445**	.264**	1.200**	.234
					(.079)	(.121)	(.465)	(.718)
Obs.	97	79	97	79	97	79	97	79
Pseudo R^2	.007	.018	.002	.010	.439	.101	.168	.167

St. errors robust to heteroscedasticity and clustered at section level.

* p ¡.1, ** p ¡.05; (1-4) ordered logit, (5-8) censored regressions.

Since 2D:4D is sexually dimorphic, 2D:4D normalized separately for men and women.

Network, T1 is the corresponding column variable at T1.

8.2 Simple Linear Regression Models

8.3 Simple Linear Regression Models Controlling for Degree Centrality

8.4 Models Using Network Measures at T1

Supplementary Tables 5 and 6 present estimation results from the same models, however the dependent variables are the network position in the first network elicitation T1 (rather than T2). 2D:4D is never correlated with the T1 position in any of these models, independently of the model specification. This indicates that the network was built between T1 and T2 and allows us to discard the notion that our results are due to previously existing social networks.

Supplementary Table 3: Association of 2D:4D with network measures at T2; simple linear regressions

	In-degree, T2		Out-degree, T2		Transitivity, T2		Between.(ln), T2	
	Male	Female	Male	Female	Male	Female	Male	Female
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2D:4D	-.221	-.690**	-.121	-.026	.061*	-.037$^{\times}$	-.541*	.026
	(.191)	(.166)	(.338)	(.321)	(.024)	(.017)	(..227)	(.381)
Network, T1	.396	.231	.048	.323	.082	-.018	.154	.089
	(.201)	(.247)	(.260)	(.272)	(.061)	(.042)	(.092)	(.089)
Constant	5.684**	4.935**	6.591**	4.447**	.460**	.466**	4.428**	3.811**
	(.667)	(.355)	(.964)	(.851)	(.040)	(.028)	(.321)	(.625)
Obs.	97	79	97	79	97	79	97	79
R^2	.041	.087	.002	.032	.105	.022	.117	.017

St. errors robust to heteroscedasticity and clustered at section level.

* p <.1, ** p <.05; $^{\times}$p = 0.111; OLS regressions.

Since 2D:4D is sexually dimorphic, 2D:4D normalized separately for men and women.

$Network, T1$ is the corresponding column variable at T1.

Supplementary Table 4: Association of 2D:4D with network measures at T2, controlling for local centrality; simple linear regressions

	In-degree, T2		Out-degree, T2		Transitivity, T2		Between.(ln), T2	
	Male	Female	Male	Female	Male	Female	Male	Female
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2D:4D	-.221	-.690**	-.121	-.026	.058*	-.032*	-.444*	.222
	(.191)	(.166)	(.338)	(.321)	(.024)	(.013)	(.162)	(.303)
Network, T1	.396	.231	.048	.323	.066	-.003	.076	.080
	(.201)	(.247)	(.260)	(.272)	(.063)	(.028)	(.044)	(.131)
Degree, T2					-.012*	.011	.297**	.383**
					(.005)	(.014)	(.055)	(.043)
Constant	5.684**	4.935**	6.591**	4.447**	.582**	.391**	1.812**	1.080
	(.667)	(.355)	(.964)	(.851)	(.053)	(.088)	(.471)	(.731)
Obs.	97	79	97	79	97	79	97	79
R^2	.041	.087	.002	.032	.159	.044	.472	.438

St. errors robust to heteroscedasticity and clustered at section level.

* p <.1, ** p <.05; OLS regressions.

Since 2D:4D is sexually dimorphic, 2D:4D normalized separately for men and women.

Network, T1 is the corresponding column variable at T1.

Supplementary Table 5: Association of 2D:4D with network measures at T1

	In-degree, T1		Out-degree, T1		Transitivity, T1		Between.(ln), T1	
	Male	Female	Male	Female	Male	Female	Male	Female
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2D:4D	-.055	-.187	.074	-.065	.035	-.055	.561	-.047
	(.187)	(.191)	(.165)	(.203)	(.121)	(.114)	(.427)	(.379)
Degree, T1					.221**	.156**	1.674**	1.679**
					(.053)	(.057)	(.179)	(.236)
Constant					-.682**	-.361	-3.406**	-3.419**
					(.210)	(.236)	(.808)	(.933)
Obs.	97	79	97	79	97	79	97	79
Pseudo R^2	.000	.003	.001	.000	.108	.054	.146	.193

St. errors (in paretheses) robust to heteroscedasticity.

* p <.1, ** p <.05; (1-4) ordered logit, (5-8) censored regressions.

Since 2D:4D is sexually dimorphic, 2D:4D normalized separately for men and women.

p = 0.324 in (2), p = 0.192 in (7), p >0.63 otherwise for 2D:4D.

8.5 Simple Linear Regression Using Network Measures at T1

Supplementary Table 6: Association of 2D:4D with network measures at T1; simple linear regressions

	In-degree, T1		Out-degree, T1		Transitivity, T1		Between.(ln), T1	
	Male	Female	Male	Female	Male	Female	Male	Female
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2D:4D	-.014	-.184	.024	.010	.009	-.014	.224	-.006
	(.155)	(.180)	(.160)	(.183)	(.043)	(.044)	(.246)	(.215)
Degree, T1					.057**	.031*	1.003**	1.082**
					(.016)	(.017)	(.092)	(.100)
Constant	1.939**	1.968**	2.001**	1.899**	.123**	.238**	.008**	-.262
	(1.66)	(.186)	(.162)	(.192)	(.053)	(.070)	(.289)	(.325)
Obs.	97	79	97	79	97	79	97	79
R^2	.000	.013	.000	.000	.094	.031	.440	.585

St. errors (in paretheses) robust to heteroscedasticity.

* p <.1, ** p <.05; OLS regressions.

Since 2D:4D is sexually dimorphic, 2D:4D normalized separately for men and women.

p = 0.308 in (2), p >0.74 otherwise for 2D:4D.

8.6 Pooled Estimates for Men and Women

Supplementary Table 7, shows that the results are virtually identical if we pool men and women into one model and include the female dummy, 2D:4D, and their interaction as regressors.

Supplementary Table 7: Association of 2D:4D with network measures at T2; pooled estimations for men and women

	In-degree, T2	Out-degree, T2	Transitivity, T2	Between.(ln), T2
	(1)	(2)	(3)	(4)
2D:4D	-.044	-.145	.060**	-.536* (p = .053)
(normalized)	(.123)	(.101)	(.022)	(.275)
2D:4D × Female	-.347**	.181	-.101**	.591 (p =.132)
	(.170)	(.319)	(.011)	(.391)
Female	-.511**	-.694*	-.021	-.920*
	(.255)	(.382)	(.050)	(.515)
Network, T1	.181**	.132	.079*	.147**
	(.087)	(.162)	(.046)	(.057)
Constant			.438**	4.247**
			(.044)	(.229)
Obs.	176	176	176	176
Pseudo R^2	.015	.013	.114	.022
p-value for females^{+}	.003**	.895	.019**	.876

St. errors robust to heteroscedasticity and clustered at section level.

* p <.1, ** p <.05; (1-2) ordered logit, (3-4) censored regressions.

Since 2D:4D is sexually dimorphic, 2D:4D normalized separately for men and women.

$^{+}$p-value for female corresponds to testing H^0: 2D:4D + 2D:4D × Female = 0.

Network, T1 is the corresponding column variable at T1.

Supplementary Table 8: Association of 2D:4D and transitivity for individuals with at least two friends

	Transitivity, T2	
	Male	Female
	(1)	(2)
2D:4D	.058**	-.025^{+}
	(.029)	(.026)
Transitivity, T1	.058	.000
	(.050)	(.041)
Constant	.476**	.501**
	(.031)	(.032)
Obs.	92	72
Pseudo R^2	-0.499	.015

St.err. robust to heteroscedasticity and clustered at section level.
* p <.1, ** p <.05; censored regressions, $^{+}$p = .333.
2D:4D normalized separately for men and women.

8.7 Models Excluding Individuals with Fewer than Two Friends

Supplementary Table 8 reports estimates analogous to Models 5 and 6 in Table 2 from the main text. However, in contrast to Table 2, individuals with fewer than two connections, for whom the clustering is not well defined, are eliminated from the regressions in Supplementary Table 8. As discussed in the main text, the association between transitivity and 2D:4D is robust for men but not women.

References

[1] Brañas-Garza, P., Kovářík, J. & Neyse, L., 2013. Second-to-Fourth Digit Ratio Has a Non-Monotonic Impact on Altruism. PloS ONE, 8(4), pp.1-10.