Prenatal Sex Hormones 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, and §Medical Genetics Division and Department of Political Science, University of California, San Diego

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The position people occupy in their social and professional networks is related to their social status and has strong effects on their access to social resources. While attainment of particular positions is driven by behavioral traits, there are many biological factors that predispose individuals to certain behaviors and motivations. For example, prior work on exposure to fetal androgens (measured by the second-to-fourth digit ratio, 2D:4D) shows that it correlates with increased confidence, status seeking, and educational/professional success, which might lead individuals to become more socially integrated. However, it also predicts certain anti-social behaviors and some disorders associated with lower socialization. Here, we measure the 2D:4D ratio of all individuals within a dynamic social network to explore whether prenatal hormone exposure is related to network position later in life. The results show that both males and females with high prenatal exposure (low 2D:4D) are likely to become more central in their social environment over time. Interestingly, low 2D:4D males are more likely to exhibit high betweenness centrality (attain positions that connect different segments of the social structure) while low 2D:4D females are more likely to exhibit high in-degree centrality (have more people name them as friends). The gender-specific association is reinforced by transitivity (the likelihood that friends of a node are also friends): neighbors of low 2D:4D men tend not to know each other, while the contrary is observed for low 2D:4D women. Our results suggest that biological predispositions influence the organization of human societies and that exposure to prenatal androgen influences different status seeking behaviors in men and women.

prenatal androgen | social networks | centrality

Abbreviations: 2D:4D, second-to-fourth digit ratio

Social and professional network structures play an important role in the development of social status and the attainment of many individual socio-economic outcomes [1–8]. While socially developed personality traits and behaviors influence one's position in social structures [9–12], many of these traits are shaped by one's biology. Specifically, a large literature connects exposure to prenatal androgen to a wide variety of behavioral traits and motivations that may have strong effects on social relationships [13–23]. But, to date, none of this research has addressed an important question: does exposure to prenatal androgen influence one's position in social networks?

The theoretical network formation literature mostly assumes that people are homogeneous and all differences in structural position arise due to linking dynamics [24–26]. However, empirical work shows that the positions people occupy in social structures correlate with individual traits and behaviors [9–12] and people cluster according to many traits and behaviors in social networks [27]. Even though this suggests that individual heterogeneity influences network formation, causality is hard to establish due to the coevolution of many individual characteristics and social relationships.

An important step towards causal identification in network formation is the use of genetic factors underlying traits that shape social structure [28,29]. Since genotypes are mostly stable over the life course, an association between genes and networks suggests that biology influences social networks rather than the other way around. Twin studies comparing network measures between monozygotic (“identical”) and dizygotic (“fraternal”) twins suggest that in-degree, betweenness centrality, and transitivity have a genetic basis, whereas they do not find any genetic basis for out-degree [28]. However, these studies cannot assess *which* biological traits influence network formation and whether the same traits may influence males and females differently. This question is crucial for further understanding of the biological basis of network formation and individual variation in positions, as well as for the interpretation of the findings from twin studies.

Several traits that shape social relationships and larger structural positions are shaped by exposure to prenatal androgens. Exposure to these hormones in the womb affects the development of the brain and the way these circulating hormones influence behavior later in life [30–32]. A commonly used biomarker for exposure to prenatal sex hormones is the ratio between the lengths of the index and ring fingers from the metacarpophalangeal crease to the finger tip (Figure 1). This second-to-fourth digit ratio (2D:4D) is negatively associated with exposure to testosterone and positively associated with exposure to oestrogen while in uterus. The ratio is also sexually dimorphic (men have lower values than women, see Figure 2) and it remains unchanged after early childhood [33–35].

Previous studies find that exposure to these hormones is associated with social status seeking [13], risk preference [14], confidence [15], empathy [16], cooperativeness [17], and a wide variety of other behavioral characteristics [18–20]. All of these traits plausibly influence social relationships and might thus affect structural positions in social networks. In addition, lower 2D:4D is predictive of attractiveness [36], and success in sports [37,38], finance [39], education [40], and the arts [41], all of which may in turn lead to high social status. Because status is naturally connected with network positions [44], we

Significance

XXX developed the concept of the study and conducted data collection. XXX conducted the analysis, data interpretation and drafted the manuscript. XXX contributed to the development of the statistical methods, data interpretation and drafting of the manuscript.

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hypothesize that low 2D:4D individuals will tend to occupy important locations in social structures.

However, low 2D:4D individuals are also more likely to exhibit certain behaviors that are not conducive to building social relationships. For example, low 2D:4D is associated with less eye contact in children [45], anti-social aggression [46], the inhibition of cognitive empathy [16], and a variety of social disorders such as autism [21–23]. These factors might mitigate or overpower the effects of the pro-social behavioral traits associated with higher prenatal androgen exposure.

Here, we combine data on 2D:4D and a sociocentric analysis of a large group of young adults. Our subjects are 247 University freshmen surveyed once at the beginning of the school year (T1) and a second time at the end (T2), in order to control for preexisting relationships. For the analysis, we elicited social ties and mapped them in a directed network in which a link between two individuals exists if one of the individuals names the other one as a friend (*Methods*).

Following [28], we focus on four primary network measures (Table 1). The first, in-degree centrality, is the number of times a person is named as a friend by others. Individuals with higher in-degree centrality are popular and can be said to have higher connectivity and visibility. The second measure, out-degree centrality, is the number of friends a subject names and reflects how popular people view themselves. Third, transitivity measures the fraction of friends of a node that are also mutual friends. Hence, transitivity is a measure of local network density and reflects how relevant one is for maintaining connectivity within her network neighborhood: nodes with high transitivity are embedded in dense neighborhoods and their removal does not greatly affect the connectivity among their neighbors. Transitivity is not formally defined for nodes with less than two links. We follow the convention of some literature [1, 3] and set it to zero in these cases in the main regressions. Last, betweenness is a global measure of centrality defined as the number of shortest paths between people in a network that pass through the individual [47]. Individuals with high betweenness centrality bridge the gap between different sections of the overall network and are likely to act as brokers between groups.

Observe that in-degree, out-degree, and transitivity characterize subjects' local positioning in the network as they are computed on basis of their and their neighbors links; only betweenness accounts for the whole network architecture. As for the three centrality measures, in-degree, out-degree, and betweenness, they represent different types of social status and give individuals differential access to social power and resources. The degree measures reflect the local status, while betweenness centrality is more wide-reaching because it is affected by the ties of people to whom the individual is not directly connected. Both in-degree and betweenness depend largely on perception of others and reflect the status one holds in the group, whereas out-degree is highly subjective as it does not have to mirror how others view the individual. Consequently, it does not necessarily translate into higher status. These network variables are combined with the 2D:4D ratio of each individual in the study (Figure 2, *Methods*).

Working with prenatal rather than circulating hormones and controlling for initial network formation are important elements in establishing causality. Since digit ratios remain unchanged from early childhood and do not vary across measurement periods, we can rule out the possibility of reverse causality that exists in other studies of behavioral traits and network formation. Observing the initial network allows us to account for any social ties that students may have had prior to the first measurement period and focus on the dynamics in the new social environment.

Results

The network at T1 was sparsely connected, suggesting that students had very few ties with their peers at the beginning of the school year. At the end of the year (T2), however, the network resembles other socially generated networks in many respects (the degree distribution is skewed, there is high reciprocity and transitivity, and high degree individuals tend to be connected to other high degree individuals [1–3], as shown in Figure 3).

During the first measurement period (T1) when few students knew one another, none of the network variables is significantly associated with male or female students' 2D:4D's (see *SI*). During the second measurement period (T2), however, we find that individuals with lower 2D:4D are more central, but males and females with low digit ratios maximize different types of centrality (Table 2). Low 2D:4D females exhibit higher in-degree ($p = .014$), but males do not ($p = .718$). In contrast, males' *global* centrality, expressed by betweenness, is negatively associated with 2D:4D ($p = .040$), but females' is not ($p = .886$). We observe that only a small part of the association between betweenness and 2D:4D in men is mediated by local degree centrality (if we control for degree at T2 in a regression analogous to (7) in table 2, the estimated β decreases by 26.5% and $p = .032$, *SI*). The association between 2D:4D and in-degree is significantly different across genders, while it is not in case of betweenness (two-tailed tests of a difference in the estimated coefficients, in-degree: $p = .041$, betweenness: $p = .132$; see *SI*).

The magnitudes of these relationships are quite large. Holding all else equal, a female in the 10th percentile for digit ratio is 23% more likely than a women in the 90th percentile to be named as a friend by 6 or more people. The average female in the sample was named 4.8 times. Similarly, men in the 10th percentile have one-half standard deviation greater betweenness centrality than males in the 90th percentile.

The detected gender differences are reinforced by the association between nodes' transitivity and their 2D:4D. The high betweenness of low 2D:4D men is accompanied by low transitivity ($p = .006$), underscoring their relevance for bridging otherwise more distant or even disconnected parts of the network. Low 2D:4D women, in contrast, are embedded in densely connected neighborhoods ($p = .025$). As a result, women with higher exposure to prenatal testosterone (low 2D:4D) are more popular and their friends are more likely to be friends with one another, compared to high 2D:4D females. This gender-difference in the association is highly significant ($p < .0001$). Since transitivity is typically negatively associated with one's connectivity [1, 2], and we observe this association in the T2 network, we again control for whether the degree centrality (T2) is a mediator of the association between transitivity and 2D:4D (*SI*). The association among men is largely unaffected by controlling for centrality. However, for women, the estimated correlation decreases by 21.3% and remains only marginally significant ($p = .059$).

Out-degree (that is, how popular people feel) is never associated with 2D:4D ($p > .24$), in line with [28], who find no genetic influence on this measure.

As a robustness check, we estimate several alternative models. First, the results generally hold if we do not control for the same network measure at the initial measurement phase T1. Second, the results are robust to pooling both genders and regressing the corresponding network measure in T2 on 2D:4D, female dummy, their interaction, and the same network measures in T1. Third, we estimate simple linear models. The models presented in table 2 use ordered logit for measures of degree centrality and tobit for betweenness and transitivity (for more information see the SI). When using a simple linear models, the association between in-degree and 2D:4D in women is strengthened, while the betweenness-2D:4D linkage for men weakens but remains significant at 10% ($p = .098$). The associations between transitivity and 2D:4D are weakened for both sexes (male: $p = .090$, female: $p = .093$). Since the associations never disappear and they show up for several network measures, we conclude that they are robust to different model specifications. Last, since transitivity is set to zero for individuals with less than two links in table 1, we estimate models (5-6) removing people with no or one connection. The association is robust to this removal for men ($p = .047$) but disappears for women ($p = .333$); the gender difference remains significant at any level ($p < .0001$). See *SI* for details of the robustness checks.

Discussion

We report an association between the exposure to fetal sex hormones and social integration. Nevertheless, the association differs radically across genders. More exposure translates into more embeddedness in local circles in women (reflected in higher popularity and denser neighborhoods), a feature typically associated with high trust and cooperative environments [42,43]. In men, high exposure leads to larger brokerage power and access to information and social resources [9, 44], manifested by bridging the gap between different sections of the network. Using the data at our disposal, we cannot fully establish the mechanism that connects high exposure to prenatal androgen with network position. Additionally, we do not have enough information to decipher *why* males and females with low digit ratios gravitate towards different types of positions in their social environment.

There are at least two mechanisms that might explain our findings. One explanation is that lower 2D:4D individuals are more *motivated* to reach advantageous positions in the social environment [52,53]. If males and females view social 'success' differently or gain different benefits from local versus global centrality, this might explain why we observe low 2D:4D males and females systematically achieving different positions. If so, it might be a good example of an interaction effect between biology, which affects the desire to be central, and the social environment, which affects the context that is relevant for men vs. women. Perhaps these differences may be attributed to differing social roles of males and females in human societies [59].

Another possibility is that the observed correlations are due to behavioral traits that are not specifically associated with status-seeking behavior. Low 2D:4D individuals tend to be more confident, physically attractive, and have more athletic ability. Perhaps these characteristics lead individuals to *gravitate* towards the center of social networks rather than being motivated to reach these positions. Moreover, a great number of characteristics correlate with 2D:4D of men but not women and vice versa. The differences in types of centrality associated with 2D:4D in men and women might be driven by the different types of mediating characteristics that manifest in low 2D:4D men and women. For instance, studies show that 2D:4D is associated with physical aggression [54], increased eye contact [45], altruism [55], depression [56], and risk taking in health behavior [57] in men, but not necessarily in women. At the same time, 2D:4D is associated with heightened cognitive empathy [16], cooperativeness [17], and waist-to-chest ratio in women [58], but not necessarily in men. Perhaps the different ways that prenatal testosterone and oestrogen exposure manifest in the behavioral characteristics of males and females explains the different types of central positions men and women gravitate towards.

An important implication of this study is that the variables observed to be associated with 2D:4D in other studies might be mediated by the effect of prenatal androgen on social network characteristics. Because no other studies in the 2D:4D literature account for social network variables, they may suffer from significant omitted variable bias. Behavioral characteristics affect social structure, but social structure also has an effect on these same behavioral characteristics. For instance, part of the reason low 2D:4D individuals might be more confident is because they occupy central positions in their social environment, which allows them to gain more confidence.

This study provides direct evidence that biological characteristics shape social relationships and social network structure. Building on previous studies that established links between genetic characteristics and individual network position, we show that prenatal hormone exposure is significantly associated with the roles that individuals play in their social environment. While we are unable to establish the exact mechanisms at play, this study takes a step forward by establishing the specific traits that shape our social relationships and detecting that the same traits may operate differently for different members of the population. Future work should replicate these results in larger samples and measure potentially mediating factors to illuminate the causal mechanisms that underlie the association between digit ratio and network positions as well as the differences between women and men.

Materials and Methods

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.

Subjects. The participants were first-year undergraduate students in economics (freshmen) at the University of Granada. In total, 247 subjects participated in at least one of the sessions; 178 subjects participated in all three measurements. 2 non-Caucasian subjects were excluded from these 178 to ensure ethnic homogeneity, resulting in sample of 176 individuals (79 females).

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. To ensure the most accurate measurement, we measured the ratio twice. The first measurement was made right after the scanning, while the second was performed 14 months later, in January 2012. The data reported in this study use an average of both measures that was normalized for men and women separately.

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. 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 (see [55] for more details concerning these sessions).

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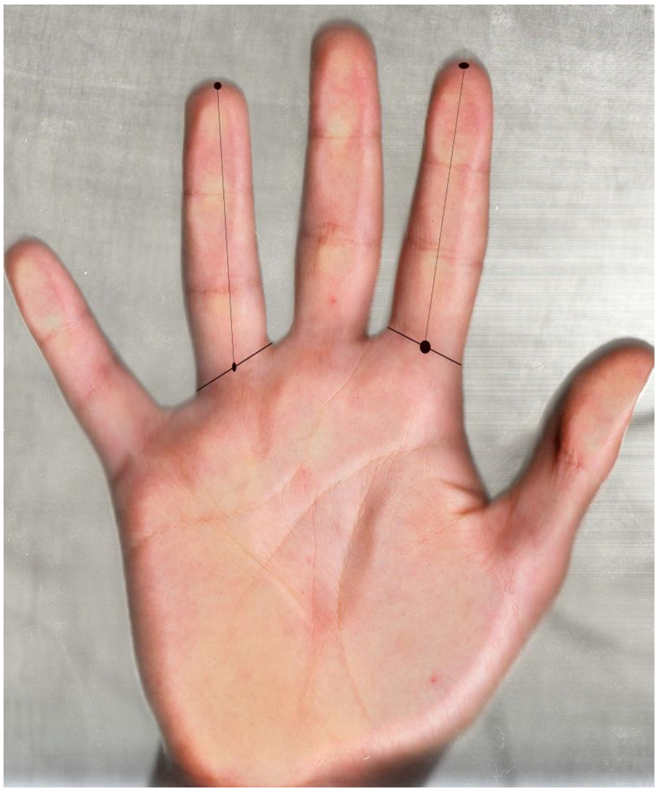


Fig. 1. An illustration of the measurement of the index (right) and ring (left) finger lengths on the right hand.

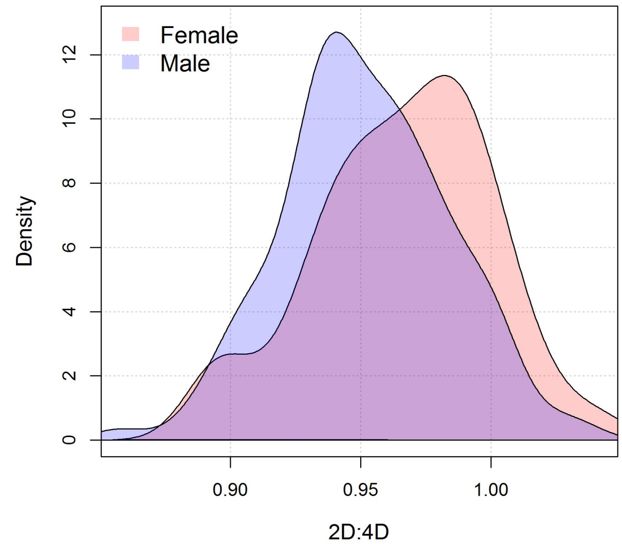


Fig. 2. The distribution of 2D:4D in our subject pool was consistent with previous studies: the trait is sexually dimorphic, with males having lower digit ratios than females on average (0.951 vs. 0.967, t-test $p = .001$). Therefore, we normalize the 2D:4D for each gender separately in the regression analysis.

Table 1. Summary statistics of the total sample.

Variable	Mean	Std. Dev.	**N***
Female			107
Male			134
2D:4D Fem.	0.967	0.033	92
2D:4D Male	0.951	0.032	110
In-degree, T1	1.921	1.637	202
In-degree, T2	5.066	3.424	243
Out-degree, T1	1.921	1.652	202
Out-degree, T2	5.082	3.682	243
Transitivity, T1	0.306	.379	202
Transitivity, T2	0.418	.273	243
Betweenness (ln), T1	2.600	2.952	202
Betweenness (ln), T2	3.976	2.451	243

*__N__ for each variable depends on the participation.

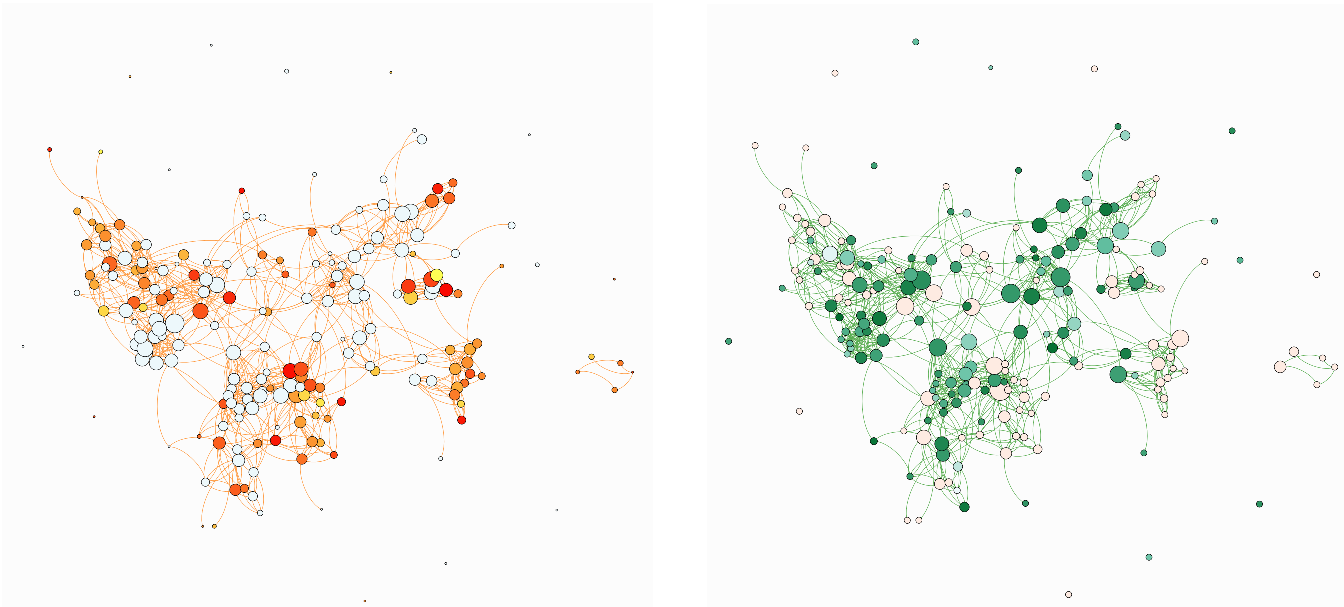


Fig. 3. Elicited social network. Left: The friend network of females (colored) and males (grayed out). Vertices are sized by in-degree centrality and colored according to 2D:4D ratio (redder nodes represent smaller digit ratios). Right: The friend network of males (colored) and females (grayed out). Vertices are sized by betweenness centrality and colored according to 2D:4D ratio (greener nodes represent smaller digit ratios).

Table 2. Association of 2D:4D with in-degree, out-degree, transitivity, and betweenness centrality in the second period T2. Since in-degree and out-degree are count variables, transitivity is censored from below by 0 and from above by 1, and betweenness from below by 0 (see *SI*), we estimated ordered logit models in (1-4) and censored (tobit) regressions in (5-8)

	In-degree		Out-degree		Transitivity		Betweenness (ln)	
	Male	Female	Male	Female	Male	Female	Male	Female
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2D:4D	-.045	-.440**	-.141	.033	.065**	-.047**	-.539**	.052
	(.123)	(.178)	(.096)	(.285)	(.023)	(..021)	(.259)	(.361)
Network, T1	.201*	.140	.068	.238	.117*	.034	.170*	.119
	(.116)	(.173)	(.159)	(.206)	(.072)	(.060)	(.096)	(.098)
Constant					.432**	.430**	4.189**	3.392**
					(.051)	(.035)	(.314)	(.687)
Obs.	97	79	97	79	97	79	97	79
Pseduo R^2	.007	.018	.002	.010	.436	.023	.024	.005

St. errors robust to heteroscedasticity and clustered at section level. * p <.1, ** p <.05.

2D:4D normalized separately for men and women.

Network, T1 is the corresponding column variable at T1.

Supplementary Information

This document provides additional supporting evidence for the results in the main text.

Supplementary Table 1. Association of 2D:4D with network measures at T2 (as in Table 2 in the main text), 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
Pseduo 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.

Supplementary Table 2. 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 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 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.

Supplementary Table 5. 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.

Supplementary Table 6. 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
Pseduo 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.

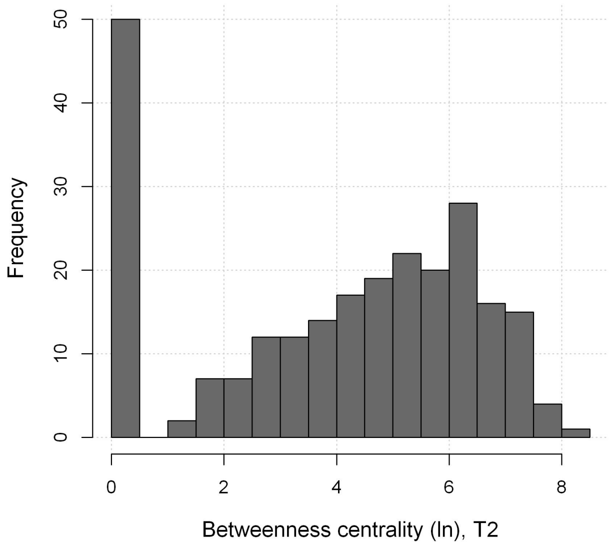
Supplementary Table 7. Association of 2D:4D and transitivity for individuals with at least two friends.

	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
Pseduo R^2	-0.499	.015

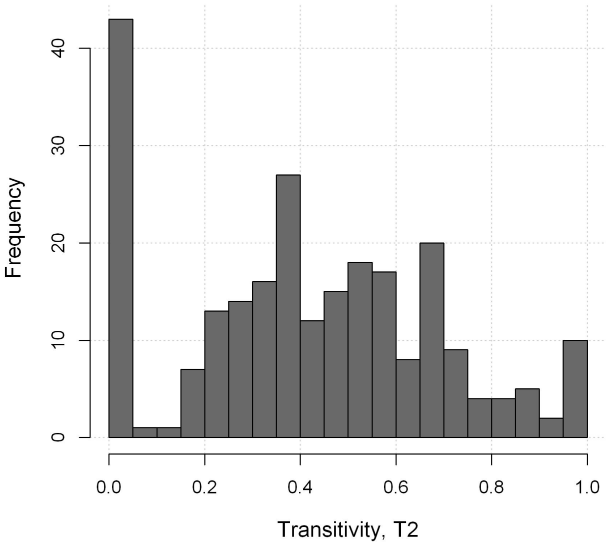
St.err. robust to heteroscedasticity and clustered at section level.

* p <.1, ** p <.05; censored regressions, $^+$p = .333.

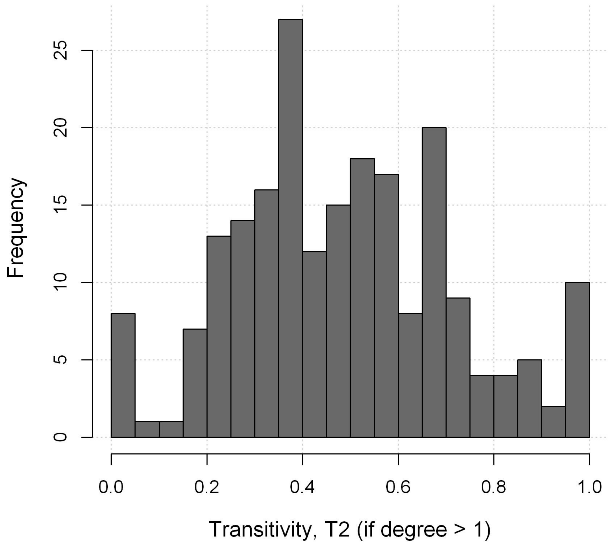
2D:4D normalized separately for men and women.



Supplemmentary Figure 1. The distribution of beetweenness centrality at T2 is censored from below by 0.



Supplemmentary Figure 2. The distribution of transitivity at T2 is censored from below by 0 and from above by 1.



Supplemmentary Figure 3. 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.