

Altruism in networks: the effect of connections

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Why are individuals altruistic to their friends? Theory suggests that individual, relationship and network factors will all influence the levels of altruism; but to date, the effects of social network structure have received relatively little attention. The present study uses a novel correlational design to test the prediction that an individual will be more altruistic to friends who are well-connected to the individual's other friends. The result shows that, as predicted, even when controlling for a range of individual and relationship factors, the network factor (number of connections) makes a significant contribution to altruism, thus showing that individuals are more likely to be altruistic to better-connected members of their social networks. The implications of incorporating network structure into studies of altruism are discussed.

Keywords: altruism; network; friendship; cooperation

1. INTRODUCTION

Why are individuals altruistic to their friends? Evolutionary psychology suggests that such altruism is primarily the product of adaptations for reciprocal altruism [1,2], which evolved to solve the problems of social exchange that were recurrent in the social lives of our hunter–gatherer ancestors. Adaptations for reciprocal altruism follow a strategy of conditional cooperation, opening interactions with a ‘nice’ move, and then either reciprocating cooperation or—if cheating is detected—withdrawing cooperation and imposing sanctions [3].

Previous research has focused on the individual and relationship factors influencing levels of reciprocal altruism. With regard to individual factors, it has been found, for example, that: cooperation in experimental games is moderately heritable [4], and influenced by personality factors [5] and temporal discounting [6]. With regard to relationship factors, it has been found, for example, that: altruism is influenced by the expectation of reciprocity and the expectation of future interaction, and is contingent upon others’ continued cooperation [7–9]; that individuals are more likely to cooperate with others when they are being watched (or made to feel as if they are being watched) [10,11]; and that individuals cooperate at higher levels when there is the option to punish cheaters [12,13].

However, theory also suggests that levels of altruism will depend not only on properties of individuals and dyads but also on properties of the larger social network in which they are embedded [14,15]. For example, to the extent that reciprocal altruism is facilitated by the

opportunity to form reputations [16], and to the extent that connections between network members facilitate reputation-formation, then increased network connections should encourage reciprocal altruism. Within such networks, individuals with more connections to other members are in effect being ‘watched’ by a larger audience; this should increase their incentive to reciprocate altruism (in terms of positive reputation), and decrease their incentive to cheat (in terms of negative reputation, and sanctions or punishment). As such, they should be more cooperative, and we should expect individuals to be more willing to engage in reciprocal altruism with them. This effect should be enhanced by the fact that altruism towards such well-connected individuals will broadcast the donor’s cooperativeness to a wider audience also.

However, there has been relatively little empirical work on the effects of network structure on cooperation, and even less on network connections, and what research there is has yielded mixed results. One study found that altruism in networks declines as a function of the ‘degrees of separation’ between donor and recipient [17]; another found that recipients of altruism ‘pay it forward’, creating ‘cascades of cooperation’ in networks [18]. One small-scale ethnographic study found that in networks of family and friends ($n = 16$), the overall ‘density’ of network connections (density = actual/total possible connections) was associated with more supportive networks, and with the degree to which reciprocity was delayed and indirect as opposed to immediate and direct [19]. Another found no effect of network density on reciprocity ($n = 29$) [20]. The present study uses a novel correlational design to test the prediction that individuals will be more altruistic to well-connected members of their immediate networks of friends.

2. MATERIAL AND METHODS

A sample of working-age adults—supplied by a commercial participant-panel supplier (Maximiles; www.maximilesgroup.com)—was recruited to complete an online questionnaire about themselves, their friends and the relationships between their friends. Each participant was paid 200 iPoints (approx. £2) for completing the questionnaire.

First, in order to investigate individual-level factors influencing altruism, participants completed a short-form assessment of the Big Five personality traits [21], including two—agreeableness and conscientiousness—thought to be most relevant to cooperation [22]. Second, in order to investigate relationship-level factors, participants identified their eight (same sex) best friends (excluding sexual or romantic partners), and answered a range of questions regarding their relationships with each of them, including two—‘For how many years have you known your friend?’, and ‘How often are you in contact with your friend?’—likely to be especially relevant to the maintenance of reciprocal altruism. Participants also completed short-form agreeableness and conscientiousness items for each friend. Third, in order to assess altruism, participants were asked to state how likely they would be on a scale of 1–7 (where 1 = ‘very unlikely and 7 = very likely’) to (i) lend £5000, and (ii) donate a kidney, to each friend. Finally, in order to assess how well-connected each of their friends was to their other friends, participants were asked to state how frequently each friend was in contact with each other friend (1–8; never/lost contact, every few years, yearly, every few months, monthly, weekly, daily and several times a day).

3. RESULTS

Two hundred and eighty-two participants completed the questionnaire (117 males, 165 females; mean age = 40.73, s.d. = 12.15), providing information

Table 1. HLM parameter estimates indexing contributions of individual, relationship and network factors on self-reported likelihood of altruistic behaviour.

parameter	estimate	s.e.	d.f.	<i>t</i>	<i>p</i>
intercept	-0.81	0.27	309.16	-3.00	0.003
sex	-0.03	0.08	281.22	-0.31	0.754
agreeableness	0.06	0.02	280.27	2.99	0.003
conscientiousness	-0.06	0.03	278.74	-2.13	0.034
years known	0.02	0	2096.11	14.28	<0.001
frequency of contact	0.16	0.01	2087.27	16.77	<0.001
agreeableness (friend)	0.04	0	2036.28	8.90	<0.001
conscientiousness (friend)	0.04	0.01	2043.93	6.66	<0.001
network connections (friend)	0.03	0.01	2227.73	3.44	0.001

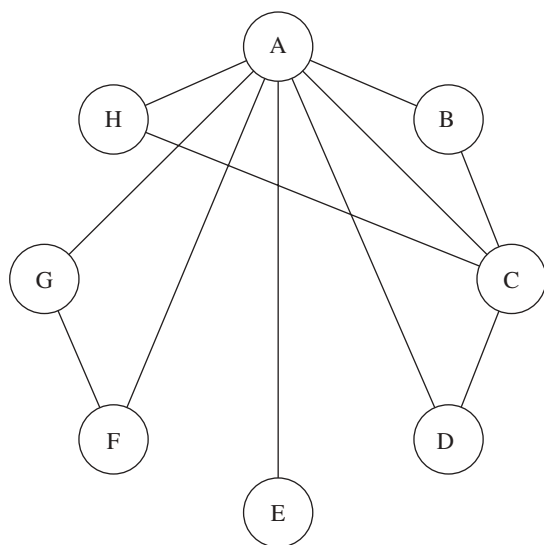


Figure 1. A sample network of friends (exhibiting median number of connections). Nodes A–H represent the participant's eight best friends; the participant (with connections to all other nodes) is not shown. In this example, friend A is the most well-connected (with the maximum seven connections to the participant's other friends); friend E is the least well-connected.

about $282 \times 8 = 2256$ relationships. A χ^2 -test revealed that the number of males and females was significantly different ($\chi^2_{1282} = 8.17$, $p = 0.004$); and accordingly participant sex will be accounted for in the remainder of the analysis.

Responses to the questions about contact frequency between friends were heavily skewed (with 55% of friend-to-friend relationships described as 'never/lost contact'), and so the original variable responses were recoded into binary variables (1 = not connected, 2–8 = connected); and these were summed to give number of network connections for each friend (0–7). An example of a network with median number of connections is given in figure 1. The two altruism measures (lend, kidney donation) significantly correlated, ($r = 0.53$, $p < 0.000$), and so they were standardized and combined to form a composite measure of altruism.

A hierarchical linear model (HLM) was used to investigate the relationships between altruism and the individual, relationship and network factors, and especially to test the hypothesis that individuals would be more altruistic to well-connected friends.

Accordingly, years known, frequency of contact, agreeableness of friend, conscientiousness of friend and network connections of friend were entered into the HLM as level 1 fixed factors. Agreeableness (participant), conscientiousness (participant) and sex (of participant) were entered as level 2 fixed factors. Participant identity (a means of identifying 'subjects') was entered as a level 2 random factor.

Parameter estimates showed that each of the individual, relationship and network variables, including network connections, made a *significant unique contribution* to altruism, but there was no *unique contribution* of sex (table 1). At level 2, the variance component associated with subjects was 0.46, while the residual variance component was 0.19 ($p < 0.001$ in both cases) yielding an intraclass correlation coefficient of 0.71. The high variance associated with 'participant' justifies the use of an HLM to control for it.

4. DISCUSSION

The present study investigated the effects of individual, relationship and network factors on altruism to friends. All predictors exerted significant contributions, with frequency of contact (between a participant and their friend) making the largest contribution. Specifically, as predicted, individuals were more likely to be altruistic to better-connected members of their social networks. This novel finding highlights the importance of social structure in explaining patterns of altruism and cooperation.

Note that the direction of argument here is that the relationship between altruism and network connections arises because well-connected members will be more cooperative, and hence will be more attractive as cooperative partners. One alternative possibility is that the causal arrow runs the other way: more cooperative individuals generate and maintain more connections. However, the findings regarding recipients' personality traits go against this interpretation. If network connections were merely a reflection of the general cooperativeness of the recipient, then we might expect the effect to disappear once we controlled for the personality of the recipient. As the results show, even when controlling for the agreeableness and conscientiousness of the recipient, the effect of network connections remains highly significant.

Note also that the conscientiousness (sample item: '... does a thorough job') of the participant is *negatively*

associated with altruism; while the conscientiousness of the friend is *positively* associated with altruism. One interpretation of this result derives from the logic of reciprocal altruism, which suggests that individuals should be willing to share resources acquired through luck, but not those acquired through effort; and similarly, that individuals should view the victims of misfortune as more deserving of help than the victims of their own indolence [23,24]. Consistent with this, individuals in the present study who considered themselves to be hard-working were less likely to be altruistic to friends, and were less likely to be altruistic to friends they perceived to be lazy. This intriguing possibility merits further study.

Finally, although the focus here was on network connections creating conditions for reciprocal altruism (through reputation and indirect reciprocity), it is of course possible that such connections may promote altruism in other ways too. For example, better-connected individuals may be higher status and have access to more valued resources, making them more valuable cooperative partners. Alternatively, to the extent that altruism is a costly signal of social status [25], altruism to well-connected individuals may broadcast this signal to a larger audience. Teasing these apart will require more thorough investigation in future studies.

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