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Altruism and Genetics

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Abstract. Three questionnaires measuring altruistic tendencies were completed by 573 adult twin pairs from the University of London Institute of Psychiatry Volunteer Twin Register. The questionnaires consisted of a 20-item Self-Report Altruism Scale, a 33-item Empathy Scale, and a 16-item Nurturance Scale, all of which had previously been shown to have construct validity. For the three scales, the intra-class correlations for the 296 MZ pairs were 0.53, 0.54, and 0.49, and for the 179 same-sex DZ pairs were 0.25, 020, and 0.14, giving rough estimates of broad heritability of 56%, 68%, and 72%, respectively. Maximum-likelihood model-fitting revealed about 50% of the variance on each scale to be associated with genetic effects, virtually 0% to be due to the twins' common environment, and the remaining 50% to be due to each twins' specific environment and/or error associated with the test.

Key words: Altruism, Behavior genetics, Empathy, Nurturance, Socialization, Sociobiology, Twins

INTRODUCTION

Although psychological research on altruism has expanded over the past 20 years, the question of individual differences has been much neglected [see 4,6,20,23-25]. This neglect is surprising because altruism has posed a central dilemma for two domains of inquiry in which individual differences are usually particularly salient. These are the domains of evolutionary biology on the one hand, and of human socialization, on the other. For evolutionary biologists, the existence of altruism raised the question of how such a behavior could evolve when it appeared to *decrease* the Darwinian fitness of the individual engaging in it [3,11,26]. For psychologists the question was, how could an infant, with no apparent interest in anything but its own immediate gratification, learn

to live life with consideration for others [6,19,20]. Perhaps oddly, neither evolutionary biologists, at least when they write about humans, nor psychologists studying the socialization process, have given much attention to the possibility of genetically based individual differences in human altruism.

At least two investigations, however, have approached the subject. Loehlin and Nichols [15], in a study of 850 twin pairs, carried out cluster analyses of self-ratings on various traits. One cluster that they labelled "kind" was made up of three bipolar adjectives "kind versus cruel", "considerate versus inconsiderate" and "patient versus impatient", and demonstrated an intraclass correlation for the 514 MZ twins of 0.26, and for the 336 DZ twins, 0.04. Applying Flaconer's [7] formula, and doubling the difference between the identical and fraternal twin correlations, broad-sense heritability is estimated at 44% for kindness.

Matthews et al [16] also carried out a relevant study using the twin comparison method. They developed an index of "empathic concern" by combining relevant items from the *Adjective Check List* [10]. Adjectives that loaded positively on their measure of empathy included "emotional", "generous", "helpful", "kind" and "sympathetic". Negatively loading adjectives included "selfish" and "selfcentered". These authors also reported their heritability estimates in terms of intraclass correlations. For the 114 pairs of MZ twins and 116 pairs of DZ twins, the intraclass correlations were 0.41 and 0.05 respectively, a highly significant difference. Falconer's formula, here, provides a heritability estimate of 72%. Of course, one of the problems with Falconer's formula is that it can somewhat overestimate broad-sense heritability under certain circumstances [13,18]. Still, it is fair to say that a significant proportion of the variance of empathic concern scores in the Matthews et al [16] study is due to genetic influence.

The present investigation was conducted to test more decisively the hypothesis of a genetic basis for individual differences in altruism. We employ three different questionnaire measures of altruistic tendencies, each of which has been used previously in the psychological literature on altruism, and each demonstrated to have construct validity. Biometric-genetic model-fitting techniques were employed to provide maximum-likelihood estimates of both genetic and environmental influences [5,8,9].

METHODS

Subjects and Procedure

In January 1982, the approximately 1400 adult twin pairs on the University of London Institute of Psychiatry Volunteer Twin Register were mailed several questionnaires. The ages of the twins ranged from 19 to 60+ with a mean of 30. About 70% of the sample were female. The twins came mostly from middle and upper-middle class families, but represented most geographical areas of the United Kingdom. The usable return rate was 1146 individuals, or 573 twin pairs. The pairs were broken down as follows: 206 MZ Female, 90 MZ Male, 133 DZ Female, 46 DZ Male, and 98 DZ Opposite Sex. This return rate and distribution is comparable to that from previous studies with this register.

Zygosity had been determined prior to the mailing using physical resemblance questionnaires adopted from Cederlof et al [2] and, for some of the twins, blood typing [14].

Questionnaires

The several questionnaires mailed out assessed the twins' perceptions of each other's personality as well as their own aggression, assertiveness, altruism, empathy, nurturance, and general and specific fears. Altogether, there were nearly 300 items. This report will deal only with the 3 questionnaires on altruism. The first of these was the Self-Report Altruism Scale, requiring respondents to report the frequency with which they had engaged in 20 specific behaviors such as "I have given directions

to a stranger", and "I have donated blood". Possible scores ranged from 20 to 100. The scale demonstrates high internal consistency and correlates with peer-ratings, situational tests, and other questionnaire measures of altruistic tendency [22]. The second scale was a 33-item measure of emotional empathy [17] consisting of such positively keyed items as "I like to watch people open presents", and negatively keyed ones as "I find it silly for people to cry out of happiness". Respondents use a 9-point scale to rate the degree of agreement they feel with each item. Scores could thus range from 33 to 297. The Nurturance Scale from the Personality Research Form [12], a well standardized omnibus personality inventory, was also used. This requires respondents to check whether 16 items refer to them. An example of a positively-keyed item is "I often take young people under my wing" and of a negatively-keyed item, "I don't like it when friends ask to borrow my possessions". Possible scores range from 16 to 48.

RESULTS

The means, standard deviations, and internal consistency (Cronbach's alpha) of the questionnaires are shown in Table 1. These are all similar to previously published data [12,17,22].

Age and sex differences were found: altruism, empathy and nurturance all increased with age, and females had higher scores than males. These results are in line with the general literature on human altruism [20]. The analyses to be reported will, therefore, employ covariance adjustments for age and sex differences.

For simplification of presentation, we report the intraclass correlations for the MZ and DZ twin paris excluding the 96 opposite-sex DZ twins, taking a weighted mean of the male and female pairs, which were covaried for age. For the Self-Report Altruism Scale, the MZ intraclass correlation is 0.53, the DZ is 0.25, and Falconer's heritability is 56%

TABLE 1 - Means, Standard Deviations, and Internal Consistency (Cronbach's alpha) of Altruism, Empathy, and Nurturance Questionnaires for Whole Sample, and Means and Standard Deviations for Each Twin Type

	Altruism	Empathy	Nurturance
Total sample, N	1146	1146	1146
Mean	53.97	180.40	35.74
Standard deviation	11.10	17.96	6.40
Coefficient alpha	0.85	0.79	0.72
MZ female individuals, N	412	412	412
Mean	55.76	203.32	37.67
Standard deviation	11.56	24.31	5.78
DZ female individuals, N	266	266	266
Mean	53.65	203.24	36.69
Standard deviation	10.53	24.54	5.51
MZ male individuals, N	180	180	180
Mean	55.09	184.10	32.79
Standard deviation	10.96	21.53	6.12
DZ male individuals, N	92	92	92
Mean	51.63	181.23	31.47
Standard deviation	10.25	23.10	6.59
Opposite-sex DZ individuals, N	196	196	196
Mean	52.69	193.11	34.64
Standard deviation	11.18	27.50	6.90

[7]. For the Empathy Scale, the MZ correlation is 0.54, the DZ is 0.20, and Falconer's heritability, 68%. For the Nurturance Scale, the MZ correlation is 0.49, the DZ is 0.14, and Falconer's heritability, 72%. These results, with the sample sizes, are summarized in Table 2.

It is, of course, now possible to go beyond simple heritability estimates based on intraclass correlations and use model-fitting approaches [5,8,9,13] . We are still at a preliminary stage of analysis and so limit ourselves to reporting the most basic of these.

Table 2 - Intraclass Correlations and Falconer's Heritabilities for the Three Questionnaires Measuring Altruistic Tendencies

	MZ pairs (N = 296)	DZ pairs (N = 179)	Falconer's heritability
Self-report altruism scale	0.53	0.25	56%
Empathy scale	0.54	0.20	68%
Nurturance scale	0.49	0.14	72%

Table 3 - Estimates of Variance Components from a Biometrical Analysis of Altruism, Empathy, and Nurturance Questionnaires

	Self-report altruism scale		
	Total sample	Males only	Females only
V (G) =	51% (60%)*	42% (49%)*	46% (54%)*
V (CE) =	2% (2%)*	7% (8%)*	7% (8%)*
V (SE) =	47% (38%)*	51% (43%)*	47% (38%)*
χ^2 =	4.2, 7df, ns	.16, 1df, ns	.56, 1df, ns
	Empathy scale		
	Total sample	Males only	Females only
V (G) =	51% (65%)*	30% (40%)*	57% (68%)*
V (CE) =	0% (0%)*	18% (23%)*	0% (0%)*
V (SE) =	49% (35%)*	52% (37%)*	43% (32%)*
χ^2 =	45.85, 7df, P < .005	.57, 1df, ns	3.07, 1df, ns
	Nurturance scale		
	Total sample	Males only	Females only
V (G) =	43% (60%)*	38% (53%)*	49% (68%)*
V (GE) =	1% (1%)*	7% (10%)*	0% (0%)*
V (SE) =	56% (39%)*	55% (37%)*	51% (32%)*
χ^2 =	35.90, 7df, P < .005	1.1, 1df, ns	4.4, 1df, P < .05

* Estimate corrected for unreliability of the questionnaire.

TABLE 4 - The Between (B) and Within (W) Mean Squares from Analysis of Variance and Their Associated Intraclass Correlations (r) for Each Zygosity Group

	MZM (90 pairs)			MZF (206 pairs)			DZM (46 pairs)			DZF (133 pairs)			DZOS (98 pairs)		
	B	W	r	B	W	r	B	W	r	B	W	r	B	W	r
Self-report altruism scale	253.62	85.67	0.50	335.16	99.19	0.54	213.18	132.76	0.23	254.17	150.50	0.26	250.39	140.41	0.28
Nurturance scale	102.05	41.19	0.43	98.17	30.70	0.52	113.85	61.65	0.30	65.60	56.33	0.08	85.16	103.40	−0.10
Empathy scale	1362.45	500.45	0.46	1865.27	49.57	0.58	1462.47	696.98	0.35	1391.92	1025.69	0.15	1127.51	1820.76	−0.24

Our procedures allowed the total phenotypic variance to be partitioned into three sources: V(G), additive genetic effects: V(CE), the between-family environmental variance, or common environment: and V(SE), the within-family environmental variance, or specific environment. Thus, the total phenotypic variance is now equal to V(G) + V(CE) + V(SE). Applying a maximum-likelihood estimation procedure to this model and including opposite-sex DZ twins, correcting for age and sex, we find for the Self-Report Altruism Scale, the additive genetic variance is 51%; for the twins' common environment, only 2%; and for each twin's specific environment, 47%. This latter contains any variance due to error in the test. Very similar results are found for the Empathy Scale and Nurturance Scale, ie, about 50% of the variance to genetic effects, and virtually zero for common environment. These results, and the χ^2 goodness of fit, are shown in Table 3. For the most part the χ^2 values are not significant, suggesting a good fit for the models. When the χ^2s indicate failure of the model, separate analysis by sex show a greatly improved fit. The results corrected for the unreliability of the questionnaires are shown alongside the maximum likelihood estimates. The mean squares from analysis of variance and their associated intraclass correlations for each of the zygosity groups are shown in Table 4.

DISCUSSION

The results from the classical twin study method of comparing MZ and DZ intraclass correlations, and those from the newer, model-fitting approaches, are in good agreement in assigning approximately 50% of the twins variance in altruism, empathy and nurturance to additive genetic influence. Moreover, the model-fitting approach suggests that very little, if any, of the twins' altruistic tendencies are due to common environment. These results agree with what has been obtained for many other personality traits [8,15,21]. It is of interest to find similar results for altruism since this is a trait that parents might be expected to socialize heavily [6,20]. Yet, approximately 50% of the variance is due to genetic influence, and most of the 50% environmental variance appears to be idiosyncratic to the particular twin. This latter is a residual term, and has a plethora of sources such as measurement error, and various kinds of genetic and environmental interactions, as well as the possibility that parents alter their socialization to suit the specific needs of the individual child and that much social learning is highly idiosyncratic in nature [1,20].

The results of this study have implications for psychological research on the origins of altruism. It supports the contention that there is an "altruistic personality" [22,23]. Future research might examine whether there is dominance for altruism, and what the correlates and consequences (both genetic and environmental) of the altruistic personality might be.

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