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Altruism and Aggression: The Heritability of Individual Differences

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Five questionnaires measuring altruistic and aggressive tendencies were completed by 573 adult twin pairs of both sexes from the University of London Institute of Psychiatry Volunteer Twin Register. The questionnaires measured altruism, empathy, nurturanoe, aggressiveness, and assertiveness. The intraclass correlations for the five scales, respectively, were .53, .54, .49, .40, and .52 for 296 monozygotic pairs, and .25, .20, .14, .04, and .20 for 179 same-sex dizygotic pairs, resulting in broad heritability estimates of 56%, 68%, 70%, 72%, and 64%. Additional analyses, using maximum-likelihood model-fitting, revealed approximately 50% of the variance on each scale to be associated with genetic effects, virtually 0% with the twins' common environment, and the remaining 50% with each twins' specific environment and/or error associated with the tea Correcting for the unreliability in the tests raised **the maximum-likelihood heritabilities to** approximately **60%.** Age and sex differences vase also found: altruism increased over the age span from 19 to 60, whereas aggressiveness decreased, and, at each age, women had higher scores than men on altruism and lower snores **on aggressiveness.**

Although psychological research on altruism and aggression has expanded over the last 20 years, the question of consistent patterns of individual differences has been much neglected. This article attempts to redress this situation. A related topic is concerned with the origins of personality traits. Although **some** schools of thought, including Freud, and the sociobiologists (Dawkins, 1976; Wilson, 1975), have stressed the importance of genetic and instinctive influences on human behavior: most current theorizing about human aggression and altruism emphasizes intraindividual variability acquired and modified through cognitive social learning (Bandura, 1977; **Rushton, 1980).** It is time that heritability estimates were brought into a discussion of these alternative viewpoints.

Despite an unsympathetic zeitgeist, there is, in fact, a peat deal of evidence that personality traits (a) **exist,** (b) are longitudinally stable, (c) can be assessed by several converging indices, and (d) are inherited (Rushton, Russell, & Wells, 1985). The heritability of individual differences in behavior may be assessed by several methods (Plomin, DeFries, & MdZlearn,, 1980). For example, selective breeding studies of animals may be undertaken, using crossfostering to control for upbringing. In humans, correlations may be calculated between scores on the trait in question and thedegree of relatedness within the family, the best known example being twin studies. Adoption studies also permit the investigator to separate the effects of environment and heredity. Finally, the trait in question may be studied in infancy to ascertain whether individual differences emerge early and remain stable over time. When studies such as these have been carried out, a significant degree of genetic influence has been detected (Goldsmith, 1983; Plomin, 1983; Rushton, 1984a; Rushton et al., 1985; Scan & Kidd, 1983). The cited reviews covered a range of normal and abnormal traits, including activity level, alcoholism, anxiety, criminality, dominance, extraversion, intelligence, locus of control, manic-depressive psychosis, political attitudes, schizophrenia, sexuality, sociability, values, and vocational interests. Many studies found that approximately 50% of the phenotypic variance was associated with additive genetic influence. As Goldsmith (1983) concluded after his review:

> With substantial confidence, it can be concluded that theories of personality development ignore the action of genetic factors at some risk. Across ages, across traits, and across methods, moderate genetic influences on individual cliff:maces have been demonstrated. (p. 349)

The current study uses the classical twin design, comparing identical and fraternal twins raised together. It is assumed that monozygotic (MZ) twins share 100% of their genes, and dizygotic (DZ) twins share, on average, 50% of their genes. Thus if the correlation between scores on a trait is higher for the MZ twins than for the DZ twins, the difference can be attributed to genetic effects to the degree that common environmental sources are assumed to be roughly equal for the two types of twin. Indeed, doubling the difference between the MZ and DZ twin correlations is one widely used estimate of **M**—the proportion of variance attributed to genetic influence (Falconer, 1981). Some have argued that the equal environment assumption is not valid. A review by Scar^{y} and Carter-Saltzman (1979) suggests that this criticism is of limited importance: In cases where parents and twins

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incorrectly classify zygosity, the degree of twin similarity on many traits is better predicted by true zygosity (defined by blood and fingerprint analysis) than by social definition. Moreover, Lochlin and Nichols (1976) showed that when measures of the differences that do exist in the treatment of twins are correlated with personality and other scores, there was no evidence that differences in treatment had any effect.

In regard to altruism and aggression, both the early emergence and later persistence of individual differences have been documented. Radke-Yarrow and Zahn-Waxler (1984) categorized the prosocial responses of I ^{1}/2 to 21/2 year olds to the distress of others into four types: emotional, cognitive, aggressive, and nonreactive. On retest at 7 years of age, two-thirds of the sample showed consistency in their category of response. Among adults, Rushton (1984b) has shown that paper and pencil measures of altruism predict a variety of laboratory and naturalistic criteria including being community mental health volunteers. Huesmann, Eron, Lefkowitz, and Walder (1984) found individual differences in aggression at age 8 correlated .46 with those at age 30, and they predicted a syndrome of antisocial behaviors including criminal convictions, traffic violations, child and spouse abuse, and physical aggressiveness outside the family. Moreover, the stability of aggression was found to exist across three generations, from grandparents to children to grandchildren.

Preliminary evidence on the heritability of altruism and aggression has been documented. Thus Loeblin and Nichols (1976) carried out cluster analyses on self-ratings of various traits from 850 twin pairs. Clusters labeled *argumentative, family quarrel,* and *kind* demonstrated heritabilities of .40. Sari (1966) had parents of twins complete the Adjective Check List (Gough & Heilbrun, 1965) to describe their children and found that aggressiveness had a heritability of .40. In a twin study using a self-report measure of empathy, Matthews, Batson, Horn, and Rosenman (1981) calculated a heritability of .72. The Psychodeism Scale from the Eysenck Personality Questionnaire, measuring hostility and a lack of empathy (H. J. Eysenck & S. B. G. Eysenck, 1975), has a reported heritability of .50 (Eaves & H. J. Eysenck, 1977; Fulkez 198 1). adoption studies demonstrate that the related phenomena of crime and delinquency have a significant genetic component (Mednick, Gabrielli, & Hutchings, 1984).

The present investigation was conducted to test more decisively the hypothesis of genetic influence on individual differences in altruism and aggression. We used five different questionnaires measuring altruism, empathy, nurturance, agvession„ and assertiveness, each of which has been used previously in the psychological literature. In addition to calculating Falconer's (1981) heritability, we used biometric-genetic model-fitting techniques to provide maximum-likelihood estimates of both genetic and environmental influences (Eaves, Last, Young, & Martin, 1978).

Method

Questionnaires

Five questionnaires were mailed out assessing altruism, empathy, nurturance, aggression, and assertiveness. The first of these was the Self-Report Altruism Scale requiring respondents to report the frequency with which they had argagal in 20 specific behaviors such as "I have given directions to a strange and "I have donated blood" (Rushton, Chrisjohn, & Fekken. 1981). 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. The second scale was a 33-item measure of emotional empathy 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" (Mehrabian & Epstein, 1972). 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, a well standardized omnibus personality inventory, was also used (Jackson, 1974). 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. The measure of aggressiveness consisted of 23 items taken from the 272 item Interpersonal Behavior Survey (Mauger & Adkinson, 1980). It consisted of positively keyed items such' as "Some people think I have a violent temper" and negatively keyed ones as "1 try not to give people a hard time:' The assertiveness questionnaire consisted of 24 items, also taken from the Interpersonal Behavior Survey, with positively keyed ones like "I usually say something to a person who I feel has been unfair" and negatively keyed ones like "1 rarely criticize other people."

Subjects and Procedures

In January 1982, approximately 1,400 adult twin pairs on the University of London Institute of Psychiatry Volunteer TWin Register were mailed several questionnaires. This register was established in the 1960s and built up over time through advertisements at Twin conventions; through newspaper radio, and television appeals; and through word of mouth. Studies based on this register have contributed much to our knowledge of the genetic basis of personality (e.g., Eaves & H. J. Eysenck, 1974, 197$, 1977; Martin et al., 1986; Full= S. B. G. Eysenck, & Zuckerman. 1980; Martin, Eases, & H. J. Eysendt, 1977; Martin, Eaves, & Fulker. 1979). The ages of the twins ranged from 19 to over 60 with a mean of 30. About 70% of the sample were women. 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 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 excess of women over men and monozygotes over dizygotes is comparable to that from previous studies with this register as well as to other volunteer twin samples (Lykken, Tellegan, & DuRubeis, 1978). Because of this recruitment bias, some truncation may exist in the measurement of altruism and related variables, particularly among the DZ males, and thus result in an underestimation of the DZ variances and an overestimation enter under souse circumstances (see Lykken et al., 1978). Zygosity had been determined prior to the mailing using physical resemblance questionnaires adopted from Cederlof, Fribers, Jonsson, and Kaij (1961) *and,* for some of *the* twins. by blood typing (Kasriel & Estes, 1976). Based on the work of Kasriel and Eaves (1976), it is likely that the zygosity diagnosis is correct for more than 95% of these twins.

Results

The means, standard deviations, and internal consistency (Cronbach's alpha) of the questionnaires are shown in Table I . These are all comparable to the published studies cited earlier. Significant correlations were found among the questionnaire measures. Aggressiveness was positively related to assertiveness ($r = .26$, $p < .001$) and negatively related to altruism, empathy, and nurturance (rs .• –.23, –.37, and –.27, respectively, ps < .001). Assertiveness was inconsistently related to altruism, nut-

Table 1
Means. Standard Deviations. and Internal Consistency (Cronbach's Alpha) of Altruism. Empathy, Nurturance, Aggressiveness. and Assertiveness Questionnaires for Whole Sample, and Means and Standard Deviations for Each Thin type

Sample	Self-Report Altruism	Empathy	Nurturance	Aggressiveness	Assertiveness
Number in total sample	1146	1146	1146	1146	1146
M	53.97	180.40	35.74	38.03	49.31
SD	11.10	17.96	6.40	7.50	9.16
Coefficient alpha	0.85	0.79	0.72	0.72	0.77
Number of MZ female individuals	412	412	412	412	412
M	55.76	203.32	37.67	36.38	48.66
SD	11.56	24.31	5.78	6.53	9.44
Number of DZ female individuals	266	266	266	266	/266
M	53.65	203.24	36.69	37.12	48.65
SD	10.53	24.54	5.51	7.96	9.29
Number of MZ male individuals	180	180	180	180	180
M	55.09	184.10	32.79	40.82	52.74
SD	10.96	21.53	6.12	6.99	7.41
Number of DZ male individuals	92	92	92	92	92
M	51.63	181.23	31.47	40.65	51.61
SD	10.25	23.10	6.59	7.44	8.59
Number of opposite-sex DZ individuals	196	196	196	196	196
M	52.69	193.11	34.64	39.57	50.05
SD	11.18	27.50	6.90	7.12	8.52

Note. MZ mcnozysote; DZ dizygote.

turance, and empathy (.30, .07, and –.10, respectively), whereas the prosocial measures all intercorrelated positively: altruism .43 ($p < .001$) with nurturance and .15 with empathy ($p < .001$), and nurturance with empathy, .47 ($p < .001$).

As shown in Table 2, age and sex differences were found: altruism, empathy, nurturance, and assertiveness all significantly increased with age (r s - .48, .43, .41, and .23, respectively, $ps <$ .001), whereas aggressiveness significantly decreased (r –.40, $p < .001$), and women had higher mean scores than men on empathy and nurturance and lower mean scores on aggression and assertiveness (is ^{se} 14.54, 13.98, 9.88, and 6.27, respectively, ps < .001). These results are in line with the general literature on human aggression and altruism (Baron, 1977; Eisenberg & Lennon, 1983; Rushton, 1980). The analyses to be reported will, therefore, use covariance adjustments for age and sex differences.

Table 2
Age and Sex Differences on Altruism, Empathy Nurturance, Aggressiveness..and Assertiveness Questionnaires

	Ass (in yens)				
[redacted]	<19	19-29	29-39..	39-49	>49
Altruism					
Males	47.37	52.19	59.61	60.69	65.70
Females	47.38	51.64	57.45	61.32	61.43
Empathy					
Males	176.73	184.46	180.79	182.69	185.17
Females	200.94	204.40	206.97	203.82	199.11
Nurturance					
Males	30.76	32.02	32.11	34.63	35.53
Females	36.27	36.76	37.60	38.61	38.85
AltIreniveness					
Males	42.38	41.59	40.71	38.44	36.00
Females	39.96	37.97	35.15	33.24	33.91
Assertiveness					
Males	51.43	51.30	53.75	47.56	53.43
Females	46.92	48.12	48.77	47.41	49.51

We first report, in Table 3, the intraclass correlations for the MZ and DZ twin pain excluding the 96 opposite-sex DZ twins, taking a weighted mean of the male and female pain' correlations, which were computed on scores covaried for age. Also shown in Table 3 is Falconer's (1981) heritability, calculated by doubling the difference between the MZ and DZ twin correlations.

It is possible to go beyond simple heritability estimates based on intrados correlations and use biometritegenetic, model-fitting

Table 3
Intraclass Correlations and Falconer's Ikritabilities (in Percentages) for the Questionnaires Measuring Altruistic and Aggressive Tendencies

Scale	MZ pairs (*N* 296)	DZ pain (*N* •• 179)	Falconer's heritability
Self-Report Altruism	.53	.25	56
Empathy	.54	.20	68
Nurturance	.49	.14	70
Aggressiveness	.40	.04	72
Assertiveness	.52	.20	64

Table 4

Estimates of Variance Components (96E) and Estimates Corrected for Unreliability (96EC) From a Biometrical Analysis of Altruism. Empathy. Nurturance. Aggressiveness. and Assertiveness Questionnaires

	Total sample		Males only		Females only	
Variance	16E	%EC	14E	%EC	96E	%EC
			Self-Report Altruism Scale			
V(G)	51	60	42	49	46	54
V(CE)	2	2	7	8	7	
V(SE)	47	38	51	43	47	38
x^{I}	(7, *N* = 573 pain) - 4.20, *its*		(1, *N* = 339 pain) - .16, *ors*		(1, *N* 136 pain) - .56, *as*	
			Empathy Scale			
V(G)	51	65	30	38	57	71
V(CE)	0	0	18	23	0	0
V(SE)	49	35	52	39	43	28
$x^{:}$	(7, *N* 573 pairs) 45.83. $p < .005$		(1, *N* = 339 pain) = .57, ms		(1, *N* 136 pairs) – 3.07, as	
			Nurturance Scale			
V(G)	43	60	38	53	49	68
V(CE)	1		7	10	0	0
V(SE)	56	39	55	37	51	32
x^{2}	(7, *N* 573 pain) - 35.90, p < .005		(1, *N* = 339 pain) ,■ 1.1,as		(I, N 136 pain) = 4.4, *p* < .05	
			Aggremivenees Scale			
V(G)	39	54	37	51	40	56
V(CE)	0	0	0	0	0	0
V(SE)	61	46	63	49	60	44
x^{I}	(7, *N* -573pain)- 20.70,0<A1		(1, *N* = 339 pairs) = 6.6, p < .01		(1, *N* 136 pain) = 11.8,P <A1	
			Amertivenem Scale			
V(G)	53	69	43	56	55	71
C(CE)	0	0	5	6	0	0
V(SE)	47	31	52	38	45	29
$x^{:}$	(7, *N* 573 pain) = 7.86, *Its*		(1. *N* 339 pain) - 3.21, *ma*		(1, *N* 136 pairs) – 2.33, *ns*	

Note. V(G) - additive genetic cam V(CE) common environment shared by both twins V(SE) specific environment

techniques to provide maximum-likelihood estimates of both genetic and environmental influences (Eaves et al., 1978; Fulker, 1981; links & Fulkez 1970). Maximum-likelihood methods have a stronger theoretical basis and use more of the information available in the twin study to estimate heritabilities. They have the added advantage of a chi-squared statistic as an estimate of the goodness of fit of the model. In this approach, the raw data are the between- and within-twin-pain variances and covariances and not correlations which may obscure relevant information (links & Fulker, 1970). The between-pain mean squares reflect both pair resemblances and pair differences, and the within-pain mean squares, *pair* differences. The genetic models are fitted to these mean squares. Since the approach was first used with human behavioral measures (Jinks & Fulker, 1970), it has been applied to a variety of traits (see Eaves & H. J. Eysenck, 1975; Fulker et al., 1980, for further detail). In our study, we partitioned the total phenotypic variance into three sources: V(G), additive genetic effects; V(CE), the common environment shared by both twins, also known as the between-families environmental variance; and V(SE), the specific nonshared environment, or that portion of the environment that is unique to each twin. This latter is a residual term that is composed of many sources including measurement error and various kinds of genetic and environmental interactions. Thus, the total phenotypic variance is equal to V(G) + V(CE) + V(SE). Applying a maximum-likelihood estimation procedure to this model and including opposite-sex dizygotic twins, correcting for age and sex, we found on the Self-Report Altruism Scale, for the additive genetic variance, 51%; for the twins' common environment, only 2%; and for each twin's specific environment, 47%. Very similar results are found for the measures of empathy, nurturance, aggressiveness, and assertiveness, that is, about 5096 of the variance to

Table 5
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 (^{4}6 Min)			DZF (133 pain)			DZOS (98 pairs)		
Scale	B	W	r	B	W	r	B	W	r	B					
Self-Report															
Altruism	253.62	85.67	.50	335.16	99.19	.54	213.18	132.76	.23	254.17	150.50	.26	250.39	140.41	.28
Empathy	1362.45	500.45	.46	1865.27	49.57	.58	1462.47	696.98	.35	1391.92	1025.69	.15	1127.51	1820.76	-.24
Nurturance	102.05	41.19	.43	98.17	30.70	.52	113.85	61.65	.30	65.60	56.33	.08	85.16	103.40	-.10
Aggressiveness	107.14	53.58	.33	123.33	49.35	.43	147.91	107.39	.16	105.53	107.07	.00	123.74	97.43	.12
Assertiveness	188.05	72.40	.44	257.60	74.67	.55	228.05	134.96	.26	215.85	149.55	.18	192.50	126.35	.21

Note. MZM monozygote male; MZF - monozygote female; DZM dizygote male; DZF dizygote female; DZOS dizygote opposite sex.

genetic effects, and virtually zero for common environment. These results, and the chi-square goodness of fit, are shown in Table 4. When the• chi squares indicate failure of the model, separate analyses by sex often show a greatly improved fit. The results corrected for the unreliability of the questionnaires *are* shown alongside the maximum-likelihood estimates. These were calculated by dividing the genetic and common environmental variance components by Cronbach's alpha. The mean squares from analysis of variance and their associated intraclass correlations for each of the zygosity groups are shown in Table S.

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, nurturance, aggressiveness, and assertiveness to additive genetic influence. Moreover, the model-fitting approach suggests that very little, if any, of the twins' altruistic or aggressive tendencies are because of their common, shared environment. Rather, the nongenetic variance is attributable to each twins' specific environment including any gene-environment interactions that occur (described later), and also to measurement error These results agree with what.has been obtained for many other personality traits (Fulker, 1981; Goldsmith, 1983). It is of interest to find similar results for altruism and aggression because these are traits that parents might be expected to socialize heavily. Yet, approximately 50% of the variance is associated with genetic influence, and most of the 50% environmental variance appears to be idiosyncratic to the particular twin.

The results of this study have implications for psychological research on the origins of aggression and altruism. They clearly indicate that the genetic basis of behavior needs to be taken into consideration if a full understanding of human personality is to be achieved. For example, because genes and environment have been confounded in most socialization research, with genetic effects being treated as nonexistent (Rushton, 1980; Scarr & McCartney, 1983), much of the literature on the parental antecedents of aggression and altruism is uninterpretable. Recent advances in conceptualizing genotype-environment correlations, however, may improve this situation.

Three kinds of genotype-environment correlations have been described: passive, evocative, and active (Plomin, DeFries, & Loehlin, 1977; see also Scarr & McCartney, 1983). Passive genotype-environment correlations occur when parents provide rearing environments that are correlated with *the* genes they have also provided to their children. Parents who are genetically disposed to being altruistic or aggressive, for example, not only pass on genes favorable to those traits but are also more likely to reinforce, model, and otherwise provide environments that enhance them (Bandura, 1977; Rushton, 1980). Passive genotype-environment correlations tend to make siblings similar to each other. Of course, siblings are not all treated in exactly the same way, a fact that often can be considered an example of the second kind of genotype-environment correlation: evocative. *Here* individuals receive responses from others that are influenced by their genotypes. For example, aggressive children are more likely to elicit reciprocal aggression from others; altruistic children, reciprocal altruism (Strayer, Wareing, & Rushton, 1979). Finally, active genotype-environment correlations involve individuals creating or selecting environments that best suit them. For exam*, aggressive and altruistic individuals select similar others with whom to associate, both as friends, and as marriage partners (Buss, 1984; Huesmann et al., 1984; Rushton. Russell, & Wells, 1984; Rushton et al.. 1985). Active genotype-environment correlations tend to make siblings less similar to each other. Thus, even within the same upbringing environment, the more belligerent sibling may observationally learn the items from the parents' aggressive repertoire, whereas his more nurturant sibling may select from the parents' altruistic responses.

The relative importance of the three kinds of genotype-environment correlation alters with development (Scarr & McCartney, 1983). The influence of the passive kind declines from infancy to adolescence, and the importance of the active kind increases over the same period. Thus variance because of *common,* shared environment, will be most noticeable in the early years and least in later years. Findings from adoption studies are in accord with this conceptualization (Scarr & McCartney. 1983). as they are with twin studies generally. In our study the twins were at least 18 years old, and many of them had lived away from home (and each other) for some time, often being married and having children of their own. Thus it is not surprising that "common environment" had so little effect and that most of the environmental variance was unique to the individual.

Many other issues arise from these findings. One concerns mechanisms. Genes do not cause behavior directly. They code for the production of proteins which lead to structures in the brain and nervous system, which affect behavior. But what are the limbic system structures or hormonal mechanisms that mediate altruism and aggression? One advantage of a genetic hypothesis is the focus it brings to underlying physiology. For example, consider the age and sex differences we found. As far as we are aware, this is the first study (admittedly cross-sectional) to demonstrate that altruism increases across the life span, while aggressiveness decreases, and that sex differences hold up so consistently across such a time period. One preliminary hypothesis is that larger amounts of a gonadal hormone such as testosterone predisposes toward aggressiveness, which in turn decreases empathy. This would explain the negative relation between aggression and altruism, as well as the age and sex differences, for testosterone production is known to decrease with age and to differentiate the sexes in the predicted direction (Hines, 1982).

Two other issues will be raised. Given that altruism evolved to be directed toward kin and genetically similar others (Rushton et al., 1984), does degree of dispositional altruism affect the breadth of in-group/out-group categorization? Specifically, do people high in dispositional altruism more readily accept diverse others than those lower? Relatedly, what is the **place of altruism and aggression in a personality taxonomy? Do those high in al**truism and low in aggression differ in other features of their personalities, reproductive strategies, and life-histories (Rushton, 1985)? Surely it is time for the individual difference perspective in altruism and aggression to be given much closer attention.

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