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Similarity in General Cognitive Ability, Creativity, and Cognitive Style in a Sample of Adolescent Russian Twins

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Abstract. Data on five tests of general and specific cognitive abilities, cognitive styles, and creativity, obtained from members of 60 identical and 63 fraternal Russian adolescent twin pairs, are presented. All tests are adaptations of standardized instruments widely used outside of the Soviet Union. Identical and fraternal twin correlations for general cognitive ability yielded a lower estimate of heritability (0.29) than generally found in other countries worldwide (0.52) although the twin correlations themselves are fairly comparable to figures from other countries and cultures — 0.83 and 0.69 for Russian identical and fraternal twin pairs, respectively, vs 0.86 and 0.60 for non-Russian identical, and fraternal twin pairs. Twin correlations for other cognitive-related abilities assessed were also comparable to correlations obtained outside the Soviet Union with the exception of creativity which yielded higher within-pair resemblance than reported in previous twin studies.

Key words: Creativity, Cognitive abilities, Twins

INTRODUCTION

Data from thousands of twin pairs worldwide have been used to examine the relative contributions of genetic and environmental influences to a wide range of behaviors [9,16]. A compilation of the world's twin data on general cognitive ability [4] indicates that approximately half of the observed variance in intelligence can be attributed to genetic factors with shared-environmental experiences accounting for an additional one-third of the total variance. A fair degree of consistency exists across countries and cultures in twin correlations for general cognitive ability.

While a number of twin studies have been conducted in the Soviet Union to inves-

tigate developmental aspects of emotion, psychophysiology, personality, and cognition [17], few published studies have reported on the heritabilities of these constructs. With regard to the heritabilities of cognitive-related abilities, only two published studies exist: the first study focussed on the heritability of intelligence [10] whereas the second study reported the heritability of a measure of cognitive style [8]. The purpose of the present paper is to add to the behavioral genetic literature arising from the Soviet Union by reporting twin correlations for a number of measures of cognitive-related abilities obtained from a sample of adolescent Russian twins.

METHODS

The present study was designed to complement an ongoing longitudinal study of behavioral development in twins being conducted within the Moscow Institute of General and Educational Psychology [7]. As detailed in the following sections, methods of ascertainment, zygosity determination, and assessment which were established for the longitudinal study were incorporated in the present study.

Subjects

The total sample included 246 children (142 girls and 104 boys) who were members of 123 twin pairs (60 MZ and 63 DZ) with an average age of 16.2 years (SD = 0.82) when they were enrolled in the study (see Table 1). The sample was ascertained through voluntary participation of individuals from a city-wide, population-based twin registry maintained by the Psychogenetics and Individual Differences Laboratory of the Moscow Institute of General and Educational Psychology. A small subset of the twin pairs were ascertained from a twins club in Leningrad (N = 4) and another small subset was ascertained by contacting school administrators in Voronezh (N = 11). Mothers of all twin pairs identified were encouraged to participate in the study and had the opportunity to be compensated for their participation. Approximately 40% of the mothers approached agreed to participate.

Table 1 - Sample size as a function of zygosity and gender

	MZ	DZ
Number of male twin pairs	26	26
Number of female twin pairs	34	37
Total number of twin pairs	60	63

All twins in the present sample had completed a minimum of 9 years education and all planned to continue their education. The educational attainment of the mothers in the sample was as follows: 9.5% had only completed the equivalent of a high-school education in the United States, 26.2% completed the equivalent of a trade or profession-

al school, and 64.3% completed a university-level education. Although it is difficult to assess the representativeness of the twins in the present sample, they are typical of college-bound adolescentes in Soviet society.

Zygosity

For research purposes, zygosity determination was based upon a combination of the physician-determined zygosity at the time of birth and information obtained from a Russian translation of a twin diagnostic questionnaire [6] based upon reported physical similarity and degree of mistaken identity at the time of assessment. When discrepancies between the two methods occurred, a direct examination of physical similarity, eight blood group markers, and dental characteristics was conducted and a final zygosity determination was made. Eleven twin pairs were excluded from the sample because zygosity could not be assigned with confidence.

Measures

An extensive battery of behavioral tests were administrered separately to members of twin pairs in two, three-hour-long sessions. An additional hour was spent interviewing individually the mothers of twins. Only the results from a subset of the measures used will be presented in this report. These measures are listed in Table 2 and a brief description of each measure follows.

Table 2 - Psychometric tests analyzed in the present report

Ability	Test	Reference	Reliability
General cognition	Wechsler Adult Intelligence Scale	Wechsler [22][a]	0.85
General cognition	Amthauer Intellectual Test	Amthauer [2][b]	0.94
Creativity	Torrance Test of Creativity	Torrance [21][c]	0.83
Field dependency	Embedded Figures	Witkin [23]	0.91
Reflection/impulsivity	Matching Familiar Figures	Salkind [18]	0.85

[a] Adapted and standardized in Russia by L.A. Baranova and M.D. Dvoryashina, [3].
[b] Adapted in Russia by M.K. Akimova et al. [1].
[c] Adapted in Russia by E.L. Grigorenko [12] and N.B. Shumakova.

General Cognitive Ability

Two measures of general cognitive ability were administered. The Russian adaptation of the Wechsler Adult Intelligence Scale (WAIS [22]) has been normed to yield a mean of 100 and a standard deviation of 15 for comparability to data collected in other countries. The Amthauer Intellectual Test [2] is a written test comprised of 4 subtests assessing general cognitive ability as well as mathematical, verbal, and spatial ability. There

are 20 items in each subtest of the Amathauer, with the exception of Mathematics which has 16 items, and raw scores (number correct) are utilized in this report.

Creativity

The Torrance Tests of Creative Thinking, Verbal, Form A [21] assesses abilities associated with divergent thinking (ie, fluency, flexibility, originality, redefinition, elaboration). The Torrance is comprised of a total of seven activities involving four sets of stimuli. Children are informed that these activities will give them a chance to use their imaginations in thinking up ideas and putting them into words. Some activities involve ambiguous stimuli (ie, a drawing of a form which is neither human nor animal looking at its reflection), or a supernatural situation (ie, "Imagine the world had ropes everywhere, connecting the clouds to the earth, clouds to clouds, etc"). Children are asked to describe the possible causes and consequences of the happenings. In other activities, children are asked to list the most clever, most interesting, and unusual ways to make a toy elephant more fun to play with, and to think of as many interesting and unusual uses for and questions about cardboard boxes as possible. Responses are scored for fluency, flexibility, originality, and elaboration which results in standard or T-scores for three dimensions (fluency, flexibility, and originality) from which a total score can then be calculated.

Cognitive Style

Two measures of cognitive style were employed in the present study. The Embedded Figures Test (EFT [23]) consists of 12 trials of identifying a simple figure "hidden" within a complex figure. The mean latency to the correct response is used as an indicator of the degree of a subject's field dependency, with quicker responses considered to be indicative of field independence and slower responses considered to be indicative of field dependence.

The Matching Familiar Figures Test (MFFT [18]) was utilized as a second measure of cognitive style. The test consists of 12 items each requiring the selection of one alternative figure (out of 8) which is identical to the stimulus. Both the average response latency and total number of errors are used to assess the dimension of reflection/impulsivity. Individuals who respond impulsively respond quickly with many errors whereas those individuals who respond reflectively respond more slowly with fewer errors.

RESULTS

The means and standard deviations for all measures of general and specific cognitive ability, creativity, and cognitive style are presented in Table 3.

For all dimensions of intelligence assessed, the twins scored at, or slighty above, average for Russian schoolchildren. Comparative data obtained from a variety of Russian schools are presented in Table 4. Data from Russian adolescents were not available for measures of cognitive style.

Table 3 - Descriptive statistics for measures included in the present study

Measure	MZ		DZ	
	Mean	SD	Mean	SD
Wechsler Adult Intelligence Scale:				
Verbal IQ[a]	110.7	11.8	114.9	11.9
Performance IQ	104.8	10.0	105.6	9.0
Full Scale IQ	108.2	11.5	111.6	10.2
Amthauer Test of Intelligence:				
Verbal Scale[a]	10.8	3.3	12.3	3.0
Math Scale[a]	7.3	2.7	9.1	3.3
Spatial Scale	10.2	2.5	10.8	2.5
General Index[a]	9.8	2.5	11.0	2.4
Torrance Test of Creativity:				
Total Index (Verbal)	63.8	17.2	67.1	18.9
Matching Familiar Figures Test:				
Response latency (in seconds)	48.7	28.0	50.3	28.5
Number of errors	9.5	6.4	8.6	5.2
Embedded Figures Test:				
Response latency (in seconds)	41.4	21.1	36.4	22.8

[a] Significant mean zygosity difference.

Table 4 - Comparative data obtained from russian adolescent schoolchildren

Measure	Sample	N	Mean
WAIS IQ	Standardization sample	500	100
Amthauer-Verbal	Gifted children	134	16.7
	Selective school	100	13.9
	General Moscow school	60	9.1
Amthauer-Math	Gifted children	134	14.4
	Selective school	100	12.1
	General Moscow school	60	7.8
Amthauer-Spatial	Gifted Children	134	13.7
	Selective school	100	10.0
	General Moscow school	60	8.6
Torrance-Verbal Index	Gifted children	111	68.3
	General Moscow school	400	55.5

In general, although both types of twins achieved average or above average scores, the MZ twins obtained slightly lower scores than the DZ twins. As noted in Table 3, the scores of the identical twins were significantly lower than the fraternal twins for WAIS Verbal IQ and the Verbal, Math, and General Index derived from the Amthauer Test

of Intelligence. Despite these mean differences, there were no significant differences in variation between the two groups. The only tests for which significant differences between male and female twin pairs were observed were the Spatial scale of the Amthauer Test of Intelligence and response latency for the Matching Familiar Figures Test.

Twin intraclass correlations for all measures used in the present study are listed in Table 5. The MZ intraclass correlation is significantly greater than the DZ intraclass correlation for two measures of general cognitive ability (WAIS Performance IQ and the general index from the Amthauer), two of the specific cognitive abilities (Mathematics and Spatial), and creativity. The MZ and DZ twin correlations are not significantly different from one another, however, for either Verbal IQ or the verbal portion of the Amthauer, WAIS Full Scale IQ, or for measures of field dependency and reflection/impulsivity.

Table 5 - Intraclass correlations and corresponding estimates of heritability

Measure	r_{MZ}	r_{DZ}	$h^2 \pm SE$
WAIS VIQ	0.82	0.68	0.29 ± 0.13
WAIS PIQ	0.83	0.58	0.49 ± 0.15*
WAIS Full Scale IQ	0.83	0.69	0.29 ± 0.12
Amthauer-Verbal	0.82	0.73	0.17 ± 0.11
Amthauer-Math	0.86	0.37	0.97 ± 0.18*
Amathauer-Spatial	0.69	0.41	0.57 ± 0.19*
Amthauer-General	0.88	0.66	0.45 ± 0.12*
Torrance-Verbal Index	0.86	0.64	0.43 ± 0.13*
MFFT-response latency	0.26	0.42	−0.31 ± 0.25
MFFT-number of errors	0.32	0.33	−0.03 ± 0.26
EFT-response latency	0.65	0.60	0.11 ± 0.17

* $p < 0.05$.

Discussion

The twin data presented here with regard to general cognitive ability are quite consistent with those obtained in other countries and cultures. Table 6 shows the range of MZ and DZ twin correlations obtained in several studies. The MZ twin correlation for WAIS Full Scale IQ of 0.83 obtained in the present study is well within the range of correlations obtained worldwide. The DZ correlations of 0.69 for WAIS Full Scale IQ and 0.66 for the Amthauer general index are slightly, although not significantly, higher than the DZ correlations presented in Table 6. This is attributable, at least in part, to the DZ resemblance for verbal ability which is also slightly higher in the Russian twin sample than in previously published correlations (compare Tables 5 and 7). On the other hand, the MZ and DZ twin correlations for WAIS Performance IQ obtained in the present study (0.83 and 0.58) are virtually identical to the worldwide compilation of data published by Bouchard and McGue in 1981 [4]. In addition to the findings on general cognitive ability, Table 7 demonstrates that the twin correlations in the current Russian sample,

Table 6 - Twin correlations obtained worldwide for general intelligence

Study		Country	N_{MZ}	N_{DZ}	r_{MZ}	r_{DZ}
Bouchard & McGue	[4]	Worldwide	4672	5546	0.86	0.60
Halperin et al	[10]	Russia	146	155	0.84	0.59
Nathan & Guttman	[14]	Israel	25	25	0.80	0.38
Sundet et al.	[20]	Norway	757	1093	0.83	0.51
Lynn & Hattori	[13]	Japan	543	134	0.78	0.49

Table 7 - Published twin correlations for specific cognitive abilities and creativity

Ability	r_{MZ}	r_{DZ}
Verbal Comprehension[a]	0.78	0.59
Verbal Fluency[a]	0.67	0.52
Spatial Visualization[a]	0.64	0.41
Mathematical Achievement[b]	0.81	0.48
Creativity[a]	0.61	0.50

[a] Nichols [15].
[b] Husen [11].

for the specific cognitive abilities of mathematics and spatial ability, are also comparable to data obtained from other sources.

In contrast to the other dimensions, twin resemblance for creativity is somewhat different in the current Russian twin sample than in a review of 10 twin studies of creativity [15]. Although differences in the process of construct measurement can contribute to variation in estimates of twin resemblance, the actual dimension of creativity may be different in Russia where the school setting does not promote individualistic expression. Furthermore, the expectation for conformity between twins may be greater in Soviet society [19] than in the United States.

In summary, the present report finds that twin correlations for several measures related to intellect are comparable to those obtained in studies worldwide. As heritability estimates are influenced by environmental contexts, this comparability across cultures is consistent with a central role of genetic factors in the expression of intellectual functioning. In contrast, variability in heritability estimates for measures of creativity suggests that environmental factors, influential in the expression of other cognitive-related abilities, may differ across cultures. Models which include direct assessments of unique and shared environments of twins are needed in order to understand better the transaction of genes and environments. Future analyses, utilizing this reported twin sample, have as their goal the incorporation of such environmental assessments in an attempt to develop and explore comprehensive developmental models.

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