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Research of intelligence and motivation
of achievement of twins

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The motivation of achievement and psychometric intelligence were studied at 85 pairs monozygotic and 84 pairs dizygotic twins at the age of 16-20 years. Diagnostics of psychometric intelligence was spent with application of the Wechsler Adult Intelligence Scale (WAIS), for diagnostics of motivation of achievement A. Mehrabian's questionnaire and H. Heckhausen's projective test was used.

In structure of the Wechsler Adult Intelligence Scale are allocated experience subtests which productivity of performance depends mainly on the saved up experience («Information», «Vocabulary» «Digit Symbol-Coding», «Arithmetic») and personality subtests which productivity of performance depends on individual distinctions («Picture Completion», «Consecutive pictures (Sorting)», «Digit Span»). The indicators of heritability received on experience subtests to subtests of the WAIS significantly above, than indicators on personality subtests.

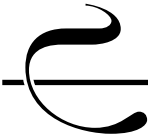
The interrelation of intelligence and achievement's motivation has complementary character and is differently shown depending on IQ: at high indicators of intelligence phenotypical correlation with achievement's motivation is positive, and at low – is negative.

The greatest influence on phenotypical variability of achievement's motivation (as implicit, and self-attributed) render shared environment factors, for self-attributed achievement's motivation presence and enough the expressed influence of genetic factors is established.

Key words: *structurally-dynamic model of intelligence, motivation of achievement, twins, heritability, common environment, shared environment.*

The psychogenetic approach to research of psychological signs was actively enough developed with reference to intelligence as a whole and to separate private mental abilities (Ravich-Sherbo I.V., 2000; Malikh S.B., 2004; Egorova M.S., 2004; Posthuma D., 2001), recently there were the psychogenetic works devoted to studying of a role hereditary and environmental of factors in phenotypical of variability of motivation of achievement (Egorova M.S., 2004) [2, 4, 5, 6, 7, 9, 13, 19].

The intelligence and motivation of achievement in the given work are considered as the interconnected elements of the uniform structure promoting adaptation of the person to vital conditions [1]. Motivation of achievement – psychological concept, reflecting aspiration of the person to achieve significant (powerful) results in certain



activity (more often results connect with educational or professional work) [17]. In the given work two versions of motivation of achievement (on Mc. Clelland D.C.) will be considered: implicit (nonverbal, it is tested with use of projective tests of type TAT) and self-attributed motivation of achievement (verbal, is tested by questionnaires) [18].

In Moscow twins the research spent by M.S. Egorova with co-authors, estimations of phenotypical variability of motivation of achievement estimated with use of a questionnaire of A. Mehrabian have been received. According to the data received in this work, genetic factors define 20 % of variability of the given characteristic [5]. Determination of motivation of achievement by a genotype can be explained or its inclusion as a component in base properties of the person, or communication with genetically caused characteristics (intelligence, temperament) [10]. Really, as it has been shown in variety of researches, the general psychometric intelligence and motivation of achievement significantly correlate at high indicators IQ [17]. Given results have found the theoretical generalisation in model «Additionality» by Heckhausen H. according to which at achievement IQ of certain (high) level real achievements of individuals depend on distinctions in motivation level, and at low level IQ motivation level cannot render essential influence on productivity any more [17].

By psychogenetic researches of intelligence it has been shown, that the estimation of the contribution genetic making phenotypical on the general intelligence makes dispersions about 50 % [5]. The estimations of heritability of verbal intelligence received in various works exceed those for nonverbal [5, 13, 20]. Last years D.V. Ushakov is developed structurally-dynamic model of intelligence which postulates, that level of heritability of special ability is defined by degree of display, involvement in it of «mental potential». The Mental potential – «individually expressed ability to formation of the functional systems responsible for intellectual behaviour» [15, p. 57]. At performance of certain intellectual activity the time and other resources spent for it, are taken away from other kinds of activity, there is «a potential distribution», and, that kind of intellectual activity which to a thicket is carried out, is more claimed in the given society, and will have higher indicators of heritability, in it in more degrees «mental potential» will be shown. So, for example, this position of the structurally-dynamic theory explains higher heritability of verbal intelligence which in a technocratic society, undoubtedly, is more claimed, than nonverbal.

In structurally-dynamic model of intelligence distinction in structure of intelligence of executive and operating processes is entered. The mechanisms which are carrying out construction or transformation of intellectual operations concern the executive, speed and accuracy of processing of the information depends on these mechanisms. Operating processes are connected with planning and the control of the actions which are carried out by executive processes. The choice of strategy of realisation of intellectual activity, persistence depends on operating processes. Operating processes are subject to action environmental factors and well trained. In structure of tests of D. Wechsler D.V. Ushakov allocates three groups of subtests: hronological (which productivity of performance depends mainly from saved up with the years experience and knowledge,



for example, subtests «Information», «Vocabulary», «Digit Symbol-Coding», «Arithmetic»); personological (which productivity of performance depends, mainly, from individual distinctions: subtests «Picture Completion», «Consecutive pictures (Sorting)», «Digit Span») and intermediate («Object Assembly», «Block Design», «Comprehension», «Similarities»). Hronological subtests, according to the spent D.V. Ushakov to the analysis of data twins the research executed by S. Vandenberg [20], give significantly higher indicators of heritability, than personological [16].

In our work following **problems** have been put:

- to estimate the contribution genetic, common environment and shared environment factors in phenotypical dispersion of indicators of verbal and nonverbal intelligence, implicit and self-attributed motivation of achievement;
- to allocate «extreme» subgroups on level IQ and to define phenotypical correlations with level of motivation of achievement;
- to spend correlation of the received results with the substantive provisions which have been put forward within the limits of the structurally-dynamic theory of intelligence.

Sample at the age from 16 till 20 years (85 steams MZ of twins have made of them male – 43 steams, female – 42 steams), 84 steams DZ of twins (male – 38 steams, female – 46 steams). Middle age of examinees – 18.3 years.

All examinees without deviations in a state of health, participated in research voluntary.

Research methods. In the course of research carrying out following methods were used: questioning, testing, twins method, methods of mathematical statistics.

The analysis method was applied to an estimation zigoticity twins polisymptomatic similarities to the questionnaire application, the developed Talyzina N.F., Krivtsova S.V., Muhamatulina E.A. [14].

Intelligence diagnostics was carried out by means of the test of intelligence of D. Wechsler WAIS adapted by employees of the St.-Petersburg research psychoneurological institute of V.M. Bekhterev [8]. The test consists of 11 subtests. All subtests are divided into 2 groups – verbal (6) and nonverbal (5).

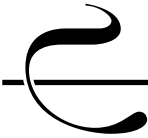
Diagnostics of self-attributed motivation of achievement was spent with application of «Questionnaire of motivation of achievement», developed by A.Mehrabian [11], implicit – H. Heckhausen projective test [12].

For an estimation of heritability and environmental influences it was used indicator of heritability by Ignatyev and following equations:

$$h^2 = 2(r(MZ) - r(DZ)); c^2 = r(MZ) - h^2; e^2 = 1 - h^2 - c^2, \text{ where}$$

$r(MZ)$ – intrapair correlation monozygotic twins; $r(DZ)$ – intrapair correlation unisex dizozygotic twins; c^2 – common environment; e^2 – shared environment [5].

Mathematical data processing was carried out by means of methods of mathematical statistics: the correlation analysis on Spearman, estimations of the importance of distinctions of factors of correlation. Computer processing of results was spent under program Statistica 6.0.



The received results

In table 1 results of the correlation analysis of intrapair similarity MZ and DZ twins on indicators of the Wechsler's test are presented.

Table 1

Intrapair correlations of indicators of Wechsler's test of MZ and DZ twins, the contribution of the genetic (h^2), common environment (c^2), shared environment, shared environment (e^2) components of phenotypical dispersion (* $p < 0,05$; ** $p < 0,01$; * $p < 0,001$) ***

Subtests		Values				
		r (MZ)	r (DZ)	h^2	c^2	e^2
Verbal subtests	Information	0,83 ***	0,42 **	0,82	0,01	0,17
	Comprehension	0,85 ***	0,54 **	0,62	0,23	0,15
	Arithmetic	0,79 ***	0,37 **	(0,79)	0	(0,21)
	Similarities	0,71 ***	0,39 **	0,64	0,07	0,29
	Digit Span	0,76 ***	0,54 **	0,44	0,32	0,24
	Vocabulary	0,81 ***	0,38 **	(0,81)	0	(0,19)
Nonverbal subtests	Digit Symbol-Coding	0,59 ***	0,29 **	(0,59)	0	(0,41)
	Picture Completion	0,78 ***	0,55 **	0,46	0,32	0,22
	Block Design	0,81 ***	0,55 **	0,52	0,29	0,19
	Consecutive pictures (Sorting)	0,67 ***	0,45 **	0,44	0,23	0,33
	Object Assembly	0,67 ***	0,38 **	0,58	0,09	0,33
Verbal IQ		0,88 ***	0,53 **	0,7	0,18	0,12
Nonverbal IQ		0,77 ***	0,51 **	0,52	0,25	0,23
The general IQ		0,85 ***	0,53 **	0,64	0,21	0,15

*The note: if $r (MZ) < 0$ or $r (MZ) > 2 r (DZ)$, h^2 equated $r (MZ)$; if $r (MZ) < r (DZ)$, $h^2 = 0$; if $r (MZ) < 0$, h^2 not calculated [5, p. 288].

Analyzing the data cited in table 1, it is necessary to note significant intrapair correlations at MZ and DZ twins on all indicators of verbal and nonverbal intelligence. On the basis of intrapair factors of correlation estimations of heritability of indicators of intelligence, and also influence on phenotypical variability of intellectual indicators of the general and divided environment have been received.

It is as a result received, that on phenotypical variability both verbal, and nonverbal indicators the greatest influence is rendered by hereditary factors, thus heritability both separate verbal subtests, and verbal intelligence above, than nonverbal (distinctions for the general indicators are significant at level $p < 0.05$).

Influence of factors of the general environment above for indicators under subtests «Comprehension», «Digit Span», «Picture Completion», «Block Design», and influence of the individual environment above under subtests «Arithmetic», «Digit Symbol-Coding» (distinctions are significant at level $p < 0.01$) «Vocabulary», «Consecutive pictures (Sorting)», «Object Assembly».



Results of an estimation of intrapair similarity MZ and DZ twins and components phenotypical are presented a dispersion of indicators of motivation of achievement in table 2.

Table 2

Intrapair correlations of indicators of MZ and DZ twins, the contribution of the genetic (h^2), common environment (c^2), shared environment, shared environment (e^2) components of phenotypical dispersion of motivation of achievement diagnosed by A. Mehrabian's questionnaire and H. Heckhausen's projective test (* $p < 0,05$; ** $p < 0,01$)

Techniques		Values				
		r (MZ)	r (DZ)	h^2	c^2	e^2
Heckhausen's test	Aspiration to success	0,41 **	0,43 **	0	0,41	0,59
	Failure avoiding	0,31*	0,32*	0	0,31	0,69
A. Mehrabian's questionnaire		0,45 **	0,26	0,38	0,07	0,55

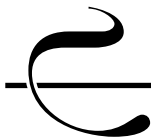
It is received, that phenotypical variability implicit motivations of achievement is defined by influence environmental factors, thus for motivation of aspiration to success the share of influences of the individual environment makes 59 %, the general environment – 41 %, motivations of avoiding of failure – 69 % and 31 % accordingly. For self-attributed motivation of achievement the share of a genetic component in phenotypical variabilities has made 38 %, and the basic influences on phenotypical variability render factors of the individual environment (55 %).

Allocation of «extreme» groups on level IQ and definition phenotypical correlations with level of motivation of achievement. Among all surveyed subgroups with high values IQ, components of 120 and more points on scale IQ, and also a subgroup surveyed with low values IQ (79 and less points on scale IQ) has been allocated. Processing of the received data with program use «Statistica» has shown, that in a subgroup with high indicators on scale IQ there is a direct significant dependence between level IQ and the expressiveness of motivation of achievement diagnosed with use of a questionnaire of A.Mehrabian ($r = 0,59^{**}$, $p < 0,01$), and also direct significant correlation dependence with expressiveness of motive of avoiding of failure by H. Heckhausen's projective technique ($r = 0,62^{**}$, $p < 0,01$) (Table 3).

Table 3

Estimation of the importance of distinctions of factors phenotypical correlations of indicators of intelligence and motivation of achievement in different subgroups on IQ (– $p < 0,01$)**

Subgroups by IQ level	Estimation of correlation with indicators of self-attributed motivation of achievement	Estimation of correlation with indicators implicit motivations of achievement
With high intelligence	0,59 **	0,62 **
With low intelligence	0,39 **	0,52 **



In a subgroup surveyed with low values IQ significant dependence between level IQ and the self-attributed motivation of achievement diagnosed by a questionnaire ($r = -0,39^*$, $p < 0,01$), thus significant negative correlation dependence with expressiveness of motive of aspiration to success by H. Heckhausen's projective technique ($r = -0,52^{**}$, $p < 0,01$) has been revealed negative correlation (Table 3).

Discussion of results. The data obtained in our work about higher indicators of heritability of verbal intelligence will be co-ordinated with results of works of other authors. So, for example, M.S. Egorova, N.M. Zyrjanova, S.D. Pjankova has been shown, that in the greatest measure the characteristics defining structure cognitive activity at teenage – the features connected with verbally – logic thinking [6] are caused by a genotype.

The data obtained by us confirm the substantive provisions formulated in structurally-dynamic model of intelligence, the offered D.V. Ushakov. So, the indicators of heritability received on hronological subtests («Information» ($h^2 = 0,82$), «Vocabulary» ($h^2 = 0,81$), «Digit Symbol-Coding» ($h^2 = 0,59$), «Arithmetic» ($h^2 = 0,79$)) significantly differ ($p < 0.01$) from indicators on personological subtests («Picture Completion» ($h^2 = 0,46$), «Consecutive pictures (Sorting)» ($h^2 = 0,44$), «Digit Span» ($h^2 = 0,44$)).

Nonverbal intelligence as ability to the analysis of the material presented in the evident form, at the person is formed in ontogenez on the basis of the verbal. This law for the first time noted by V.N. Druzhinin [3], proves to be true our data about indicators of heritability both nonverbal intelligence as a whole, and its separate factors (subtests) which in enough high degree are determined environmental by influences.

Success cognitive activity is defined not only intellectual resources of the subject with which it can involve for its realisation, but also and substantially by an end result anticipation, image of «success» or «failure» which develops at the subject and defines its motivational strategy.

Received in our work environmental determination phenotypical variabilities implicit motivations of achievement (it is bad verbalized, according to J. Atkinson) can testify that the given kind of motivation of achievement is formed in ontogenez on the basis of self-attributed motivation of achievement. Self-attributed and implicit motivation of achievement differ first of all in the ways of expressiveness in consciousness of the subject. In the first case is a verbal material, and in the second – nonverbal, figurative. Implicit the motivation of achievement is formed in ontogenez on the basis of self-attributed, as nonverbal intelligence – on the basis of verbal.

In our work it is received, that at high indicators of intelligence the surveyed have an advanced self-attributed motivation of achievement, and also expressed implicit motive of avoiding of failure. For surveyed with low values of intelligence value IQ, the above motivation of achievement which has compensating low IQ character have been established, that the more low, thus at the surveyed is expressed implicit motive of aspiration to success. Thus, at high indicators of intelligence phenotypical correlation with motivation of achievement has a positive sign, and at low – negative.

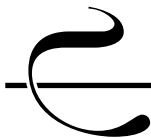


Conclusions

1. The indicators of heritability received on hronological subtests of the test of D. Wechsler significantly above, than indicators on personological subtests that confirms position of the structurally-dynamic theory of D.V. Ushakov that the contribution of hereditary factors is higher for those abilities which are claimed environment and are often realised by the individual.
2. The interrelation of intelligence and motivation of achievement has complementary character and is differently shown depending on IQ: at high indicators of intelligence phenotypical correlation with motivation of achievement is positive, and at low – is negative. At high indicators of intelligence improvement of intellectual efficiency is reached at the expense of actualisation of motivation of aspiration to success and, the it above, the above there will be real achievements of the individual. At people with low intellectual indicators improvement of intellectual efficiency is reached at the expense of actualisation of motivation of avoiding of failure, and, than the motivation of avoiding of failure is more expressed, especially high indicators of intellectual efficiency can be reached.
3. The greatest influence on phenotypical variability of motivation of achievement (as implicit, and self-attributed) render shared environment factors, besides, for self-attributed motivation of achievement presence and enough the expressed influence of genetic factors is established.

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