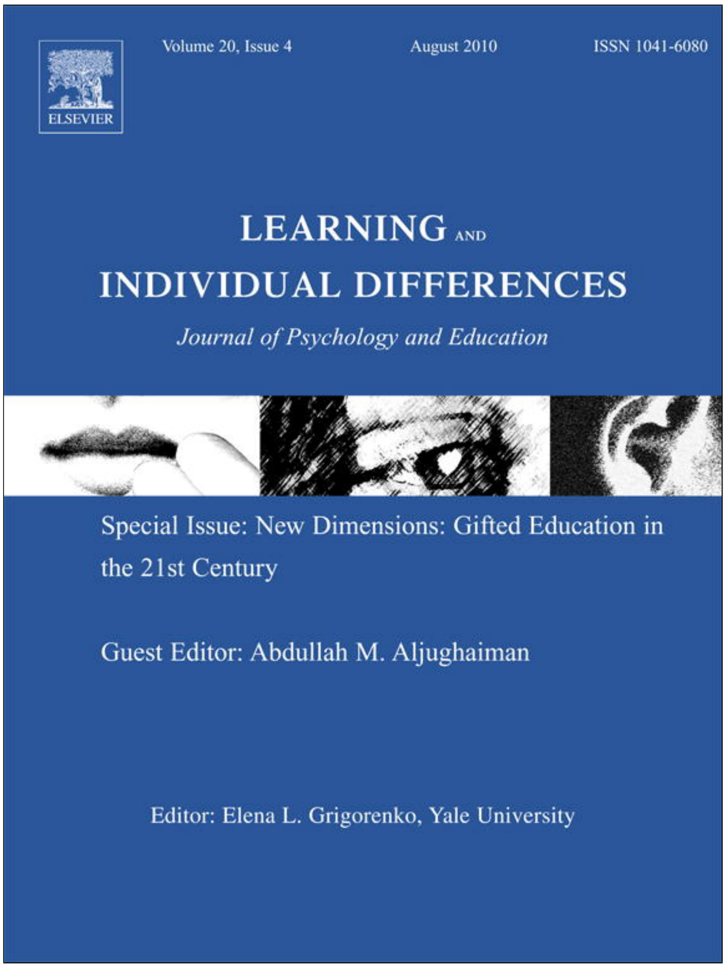

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# Olympics of the mind as a method to identify giftedness: Soviet and Russian experience☆

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ABSTRACT

The history of Olympics of the mind in the former USSR, now Russia, can be connected to the entire system of identifying and fostering giftedness within the country. The development of educational opportunities for the gifted has reflected the country's practical needs in stimulating research and advancing technologically, as well as for major ideological requirements.

A research done on over 800 participants in the final round of a Moscow intellectual competition is reported. Tests assessing intelligence, creativity, and personality were administered. The consistency of Olympics' results scales is found to be weak. The APM score correlation with Olympics' results, even in mathematics, did not exceed the value of $r = .30$.

Thomas Hobbes proposed that people's social interactions are ruled by the “social contract” that provides protection in exchange for giving away their power to the government (Hobbes, 1651/1994). According to a modern view, the national educational system can also be understood as a social contract between different groups: students, their parents, educators, central government, local communities, etc. Such a contract functions as a compromise between these groups' goals and intentions (Kondakov, 2008). The history of gifted education within the USSR and Russia is illuminated by this concept. The relative influence of the central government, local authorities, research institutions, and individuals in education has evolved considerably over many decades. Consequently, profound changes have occurred in attitudes towards gifted education methods.

Although social relations in the USSR were very different from those in Western countries, a more thorough analysis reveals striking parallels in the main influences that determined gifted education. In the USSR, as in the West, it was widely accepted that all students have equal access to all educational opportunities. However, special curricula is necessary for exceptional students, such as students who are gifted and, or, mentally challenged and have special needs. Essential reasons for devoting special effort towards gifted education were delineated by Luis Jung, a Western politician and former President of the Parliamentary Assembly of the Council of Europe. In a meeting with Eurotalent's representatives in 1998, Jung proposed the following main goals for gifted education: to use gifted individuals' potential for social benefits (development of scientific research, technologies, etc.), to contribute to the personal development and happiness of gifted individuals, and lastly, to obtain spectacular results.

Clearly, these goals are not equally important for all affiliates of the educational process. For example, while gifted students and their parents may be primarily concerned with self-realization and personal happiness, the principal concern for the central government may be to use the intellectual potential of gifted students' in order to enhance the economy and power of the state. However, these aims can work together; a person's self-realization can contribute to economic or scientific progress. Still, these goals may also be in conflict, as is sometimes the case with sports, where one's health often suffers in pursuit of success. In addition, public financial resources for education are always limited. Students who are not identified as gifted and their parents, as well as central and local authorities, have no reason to devote too much of such limited resources to gifted programs in order to spare them for other educational purposes.

Different goals corresponding to gifted education establish the context of a culture, the Macrosystem of the educational environment (Bronfenbrenner, 1996). This Macrosystem deeply affects Exo-, Meso-, and Microsystems, e.g. real practices used to identify and work with gifted children and adolescents. Social changes inevitably require modification of the Macrosystem and trigger a new search for gifted education possibilities. Transitions have occurred in the system of gifted education in Russia since 1945, but were most profound at the beginning of the 1990s. During this time, the government's influence had subsided, resulting in more freedom for individuals and local institutions to adapt education to their needs. In short, social benefit, as the main focus for gifted education throughout the Soviet period, gave way to goals motivated by self-realization (Jeltova & Grigorenko, 2005).

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## 1. Fundamental social values and gifted education

In addition to the goals, education is also underlined by another important factor: changing social values and ideology. Once again, despite evident cultural an ideological differences between former Soviet and Western regions (Schwartz, 2007), parallels can be found in attitudes towards giftedness, intelligence, and their genetic bases. Claims such as, "All people are gifted"[1] or "Individual differences in achievements are mainly due to environment or persistence" are accepted in Western cultures, yet were cultivated in communist Russia. On the contrary, in both the West and the USSR, claims like, "Giftedness is a rare phenomenon mainly based upon genetics" or "Individual difference in achievements are mainly due to genetic factors" are not welcomed. Of course, these concerns reflect only public opinion. From a scientific perspective, these statements are one-sided, and as a result, often misleading.

These ideological issues affect practices of gifted education and especially the identification of giftedness. The selection of program participants for the gifted in the USSR, especially pupils for advanced math and science schools, was based mainly on Olympics of the mind. Public opinion perceives the results of Olympics as over-relying on efforts exerted by the subject, more so than ability tests that do not require special preparation. Thus, psychological assessment methods in order to identify giftedness are commonly perceived as measuring "independent of practice" or even "innate" characteristics. In scientific terms, the argument that measures of cognitive ability are genetically charged while the results of Olympics are not, doesn't make sense. Nevertheless, identification of giftedness is considered fairer if the child or adolescent has been allowed to work previously on the subject where he or she is assessed. Consequently, the Olympics are much more acceptable than intelligence testing for a society that is sensitive to, and has little tolerance, for the problem of individual differences in abilities and their genetic roots.

All these factors established Olympics as a widely used tool for identifying intellectually gifted children in the USSR. Even though changes in Russian society have greatly influenced practices of identifying and fostering giftedness, the Olympics have remained an important feature of Russia's giftedness identification system.

Below, I will briefly describe the history of the Olympics of the mind in Russia. Subsequently, on the basis of empirical research, I will compare them to psychological testing as a method for identifying the gifted.

## 2. Evolution of the system of identification of the intellectually gifted in the USSR and Russia

When education is only available to certain young people, it is always, at least to a certain degree, "gifted education." The problem of special programs for the gifted arises only when education becomes available to the masses and the variance of abilities among students increases. In the USSR, this problem first appeared in the 1930s and gained importance after World War II, when higher education became universal.

Although The Astronomic Society of Russian Empire already held "Students' Olympics" in the 19th century, the real beginning of the Olympics tradition in Russia can be traced to the 1930s. Boris Delone, a mathematician and corresponding member of the Academy of Sciences, organized the first Olympics of the mind in Leningrad in 1934. The second Olympics of the mind took place in Moscow in 1935 with 314 participants. Olympics in physical sciences and chemistry started in 1938 and were organized by Moscow Lomonosov University.

The Soviet Olympics movement was interrupted by the tragic events of World War II, but after the war new factors emerged that influenced Soviet gifted programs. Competition with the USA over nuclear weapons, missiles, and, later, space exploration prompted Soviet leaders to strongly support research in physical science and mathematics. Leading Soviet researchers were given ample opportunity to develop the infrastructure of their institutions, and among other concerns, they tried to support the emergence of the new generation of talented scientists.

A number of important measures were recognized in this area during "Khrushchev's period" at the end of the 1950s and the beginning of the 1960s. A powerful Olympics system was created and a number of structures were built for the education of mathematically and scientifically gifted children and adolescents. In 1963, under the resolution of the Soviet government, four special full-board schools for mathematically and scientifically able children were created at Moscow, Leningrad, Kiev, and Novosibirsk Universities. Previously, the systems of distance education and summer schools in mathematics and physics had been established. Both distant education and summer schools served as tools for identifying gifted children in addition to their educational functions.

Since 1970, a special physics and mathematics magazine, "Kvant," has been published for school students. In the USA, English-language translations from "Kvant" were published by Quantum, a bimonthly journal of the National Science Teachers Association, in cooperation with Springer-Verlag New York, Inc.

I will not discuss here the details of the Soviet system of gifted education, but rather concentrate on the problem of giftedness identification that was mainly associated with the Olympics of the mind. At the end of the 1950s, some local Olympics in mathematics and physical science associated with leading universities, and sometimes school districts, emerged mainly under the initiative of universities and scientific institutions wishing to recruit talented youth for scientific research. Gradually, the Olympics of big universities succeeded in recruiting the winners of competitions at the school or school district levels.

In 1960, Moscow Lomonosov University, the most influential Soviet university, held the first large-scale Olympics in mathematics with participants from different regions of the country. The following year, in 1961, the mathematical Olympics obtained the official title of "Russian Republican Competition".

During this period, the Soviet Union consisted of 15 republics, among which the Russian Federation was the biggest. The republics contained regions ("oblasts") that, in turn, included several districts. Thus, the Republican level was rather high, but was not yet at national level. The 1961 Olympics was not only a Russian event, as students from almost all Soviet republics participated. Nevertheless, the Olympics of mathematics officially obtained the title of "Soviet National Competition" only in 1967, when it was held in Tbilisi, Georgia.

The Olympics in physics followed the mathematical competitions with a slight delay. In 1962, the Moscow University of Physics and Techniques (MFTI) organized an Olympics in physics with 6000 student participants. The organization of this competition was special: MFTI students from different Russian regions administered Olympic tests to pupils in their hometowns during their winter break.

In 1963, the MFTI joined forces with the Moscow Lomonosov University to organize "The Olympics in Physics and Mathematics of the European part of the USSR and Caucasus." The selection for this competition was carried out in 167 towns, and the final tour was held in Moscow.

The same work was done in Siberia. In 1962, the Siberian department of the Academy of Sciences held the All-Siberian Olympics in physics. The final round of this Olympics was organized during summer school and served as the entrance exam for the full-board special school affiliated with the University of Novosibirsk.

Chemistry was the third Olympics subject. The Olympics in chemistry in the USSR started in 1938, the same year as the physics competitions. The Moscow city Olympics have existed since 1944. The Russian republican level was reached in 1964, and the national level in 1967.

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[1] The slogan of the Russian educational newspaper "September 1" is: "You are all gifted, you are all talented".

Other disciplines followed mathematics, physics, and chemistry. The biology Olympics has never reached the national level in the USSR and only reached the Russian republican level in 1979. The Olympics in Astronomy has only been held at the Moscow regional level.

In 1964, the Ministry of Education, Communist Youth Organization (Comsomol), Central Committee, and Academy of Sciences decided to create a united organization committee of Olympics of the mind with physics' Nobel Prize, academician Petr Kapitsa, as its head. Under the administration of the united committee, a global system of Olympics of the mind emerged. Between 1966 and 1974, Olympics in mathematics, physics, and chemistry were organized at four levels: school, district (or town), regional (oblast), and national. The winners of the school competitions participated in the district's Olympics, district winners — at the regional competition, etc. The national level competitions were held in republican capitals or in large Russian cities. Since 1967, the winners of the national Olympics have won the right to enter the best universities without additional tests.

At the same time, the system of distance Olympics was developed. Some national and regional newspapers published tasks and collected answers from schoolchildren. Shortly after, the distance Olympics was accepted as a selection competition for the republican-level Olympics as an attempt to help children from remote Russian villages.

The ample system of Olympics of the mind in the USSR involved many able children and assured the Soviet team top standing at international intellectual competitions.

The traditional intellectual Olympic competitions in the USSR involved solving very difficult problems that did not require knowledge beyond the school curriculum, but did involve creative application of the knowledge. From time to time, attempts were made to improve this approach and make it more diverse. For example, in 1971 at the national competition in Riga, a “research task” was included for the first time where each participant had to choose one problem that he or she found interesting and propose an original way to approach it. Another idea aimed at equalizing starting conditions for the participants, independent of the level of their previous knowledge. The competition began with a lecture on a topic that was previously unknown to the participants and then they were asked to solve a number of problems related to the topic.

The high official status of the Olympics in the USSR had negative consequences as well; it inspired the creation for a kind of Olympics training industry. Of course, Olympics' tasks have always involved atypical problems requiring much creativity, but it is not impossible to train children to solve these specific kinds of tasks. It has been argued that the training involved in solving Olympics' problems formed sportsmen, instead of scientists.

After 1991, important changes occurred in Russia's system of gifted education. The powers of the central government, which was in a situation of acute crisis, subsided. Consequently, autonomy of individuals and organizations (both private and public) increased considerably. As a result, most “governmental” goals in gifted education (e.g., strategic interest in developing certain scientific and technical branches) lost some of their importance in favor of more “private” or “collective” goals (e.g., universities' interest for recruiting talented students or parents' motivation to help with the self-realization of their children). Proliferation of different kinds of Olympics of the mind was one of the consequences. Different universities, higher school institutions, high schools, and private associations, now less dependent on government authorities, created a number of different Olympics of the mind in addition to the central system, which continued to function, but its range decreased.

Today, Olympics are held in 19 academic disciplines. The Ministry of Science and Education of Russia issued in 2008 a list that recognizes 120 Russian Olympics of the mind in three categories. Each category represents a certain level of possibility for the winners to enter a higher school. The first and highest category was assigned to 30 Olympics, the second – to 12, and the third – to 78.

## 3. Olympics and psychological assessments as methods to identify giftedness

To identify giftedness means to detect children who have the potential to become exceptional scientists, writers, managers, sportsmen, engineers, musicians, etc. The challenge is how to recognize such a potential. Measuring cognitive abilities is one possibility. Research cited below suggests that cognitive strength is essential for success in a scientific career, more so than in music, art, and political careers. This being the case, intelligence can be considered an important factor for scientific giftedness and intelligence assessment can be applied as part of identification for scientific giftedness. Regardless, ability assessment as a method for identifying giftedness requires that predictive validity of the abilities is clear.

Another way is to analyze the success of children and adolescents in real-life activities, which are similar to professional activities. For example, nowadays, analyses of real activities are a better way to identify gifted musicians and artists. An Olympics' mathematical problem and solution, resembles a mathematical problem and solution at a professional level. Consequently, one may hypothesize that performance in Olympics can accurately predict scientific success.

Some attempts to assess the predictive validity of the Olympics' success have been made. Subotnik and Steiner (1995) assessed the achievements of the 1983 Westinghouse science talent search winners in scientific research, engineering, and medicine over the 12 years following their victory and reported rather encouraging data. A number of studies on American participants in international Olympics have been carried out by James Campbell. He reports considerable life success of participants in Olympics in mathematics (Campbell, 1996) and in physics (Feng, Campbell, & Verna, 2001). However, attempts to assess the predictive validity of Olympics of the mind may encounter some methodological difficulties. The partial return can produce systematic bias. For example, Feng et al. (2001) report receiving 55 answers to 80 requests. Yet, as research and common sense tell us, those gifted persons who have not met expectations for their success are prone to not respond to questionnaires asking about their achievements (Freeman, 2001).

At the same time, much evidence shows that psychological tests predict life outcomes. Intelligence tests are known as the best predictor of professional success (Gottfredson, 1996; Hunter, 1986). In a classic study, Roe (1952, 1953) managed to study 64 eminent American scientists and discovered in the sample mean-IQs between 137 and 160 for quantitative, spatial, and verbal intelligence.

Creativity is another candidate predictor of life achievements (Cramond, 2005). In the golden age of creativity research[2] E.P. Torrance started a longitudinal study to assess the predictive validity of his creativity test. He managed to show a correlation of about $r = .40$ of adolescents' creativity test scores with their creative achievements 22 years later (Torrance, 1988). The predictive validity of intelligence tests in the same research was slightly lower. Re-analyses of Torrance's data using linear-structure modeling did not show a considerable increase of the model's fit when intelligence was added (Plucker, 1999).

An important problem that has attracted little research attention is whether intelligence and creativity scores are good predictors of Olympics' results. The studies of Olympics' winners' life success typically did not control for psychometric variables, such as intelligence and creativity. However, one can hypothesize that the success in solving difficult Olympics' problems depends heavily upon cognitive ability and consequently the winners of Olympics are very intelligent and creative adolescents. If it is so, we can expect that Olympics' results predict life outcomes because they are highly correlated with cognitive ability.

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[2] Barron (1988) indicates the exact time limits of this period: 1950–1969.

To test this hypothesis, we carried out a study on participants in the final round of the Moscow Intellectual Marathon, a multi-subject Olympics of the mind in the Moscow region (http://intmarathon.ru). The aim of the research was not only to investigate cognitive abilities (intelligence and divergent thinking) as factors of Olympics' results but also, more importantly, to assess the amount of variance shared by Olympics with cognitive abilities, in order to compare them as potential predictors of future-life outcome.

## 4. The present study

### 4.1. Participants

Participants in the final round of the Moscow Intellectual Marathon took part in the study. To reach the final round, all children had to obtain good results in the selection round. All participants in the final round were asked to take part in our research. Among 818 participants were administered at least one test and 700 persons took all of the research tests. The number of participants is shown in Table 1.

### 4.2. Methods

Three psychological tests were administered to the subjects:

1. Raven's Advanced Progressive Matrices (APM). The standard procedure of this test stipulates either a time limit of 40 min or no time limit at all. In this research, a 30-minute time limit was applied for two reasons. First, the time allotment for administration of psychological tests at the Olympics was rather strict. Second, we tried to avoid the ceiling effect in intelligence on average adolescents. In fact, only one of 711 intelligence test takers reached the ceiling of 36 points on 36 APM tasks in 30 min. The shortcoming of this approach is the impossibility of comparing our results with the population mean.
2. The Russian version of the Unusual Uses Test (UUT), modified by Averina and Sheblanova (1996). Ninth- to eleventh-graders completed the “Wooden ruler” test, and fifth- to eighth-graders, — the “Newspaper” test. Different scales – fluency, flexibility, originality – can be derived from the UUT scoring. Many authors guided by both correlational (Dixon, 1979; Treffinger, 1985) and factor analytical results (Clapham, 1998; Michael & Bachelor, 1992; Runco, Plucker, & Lim, 2001) propose that divergent thinking is unifactorial. However, in a more recent research K. Kim (2006) shown for the non-verbal part of Torrence, tests a better fit of the two-factor model in comparison with the single factor one. In this case, fluency and originality belong to the first factor, while elaboration and abstract naming belong to the second. In the case of UUT, where parameters like elaboration cannot be calculated, the single factor interpretation is the most appropriate. In the further analyses the fluency was used as the single UUT score. The advantage of this parameter, in comparison with originality, is its independence of sample norms for response frequencies. These frequencies can be peculiar for the gifted subjects.
3. Three personality scales measuring: 1) frustration (9 items), 2) anxiety (12 items), and 3) loneliness (7 items) were administered. These scales, elaborated in Russia by A. Skrynnikov, have good psychometric properties according to the author's report (Almanakh psychologicheskih testov, 1996). These scales have been chosen for the research as loneliness, anxiety, and unstable self-esteem and are often reported as frequent problems in gifted children and adolescent (Freeman, 2001; Wiener, 1956).

We also analyzed participants' Olympics' task results. The Olympics' tasks were different for different school grades. The subjects completed tasks in humanities, science, and mathematics, and their number varied from 13 for fifth-graders to 27 for eleventh-graders. Specialists in corresponding subject matters — mathematics, physical science, astronomy, chemistry, biology, history, and Russian literature, designed the task. Tasks were not piloted previously in the competition.

### 4.3. Procedure

All tests were administered in groups of 20 to 30 subjects. The investigation was conducted at two times. The first testing took place at the Olympics for ninth- to eleventh-graders and lasted for three days in December 2001. On the first day, the subjects took the intelligence test. On the second day, they were administered the creativity test, and on the third day, — the personality inventory. The second testing session took place in February 2002 in connection with the Olympics for fifth- to eighth-graders and lasted two days. This time, only intelligence and creativity tests were administered, and the personality inventory was omitted. In all cases, psychological tests were administered in the morning before completion of the Olympics' tasks.

The Olympics' organizers did Olympics' task scoring. The partial credit method was applied to scoring.

## 5. Results

### 5.1. Scale consistency and factor analyses of Olympics tasks

Olympics' tasks are typically designed without much care for their psychometric properties. The first aim of the present study was to assess whether or not Olympics' results can be seen as consistent indicators of a subject's performance.

Data was analyzed separately for each school grade. First, scale consistency was assessed. Cronbach's $\alpha$ ranged from .40 to .74. Only 8 of 17 scales reached the more or less acceptable level of Cronbach's $\alpha$>.70.

A factor analysis was conducted to assess whether Olympics' tasks really form factors corresponding to the Olympic prizes (mathematics, sciences, and humanities). In most cases, the number of factors did not correspond to the number of nominations. For example, for ninth- to eleventh-graders, the astronomy tasks that were included in the mathematical competition, in fact, did not correlate with the mathematical tasks.

**Table 1**
Number of subjects.

| Grade | Age | | *N* | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Humanities | Physics | Mathematics | Intelligence | Creativity | Personality test | All the tests |
| 5 | 10.6 | .53 | 86 | – | 84 | 73 | 73 | – | 72 |
| 6 | 11.5 | .54 | 123 | – | 124 | 105 | 105 | – | 104 |
| 7 | 12.7 | .52 | 94 | – | 97 | 80 | 80 | – | 76 |
| 8 | 13.5 | .58 | 105 | – | 107 | 89 | 89 | – | 87 |
| 9 | 14.5 | .55 | 127 | 129 | 125 | 120 | 120 | 120 | 120 |
| 10 | 15.2 | .63 | 115 | 118 | 119 | 109 | 109 | 109 | 106 |
| 11 | 16.2 | .61 | 156 | 147 | 153 | 135 | 135 | 135 | 135 |
| Total | | | 806 | 394 | 809 | 711 | 711 | 364 | 700 |

For further analyses, we formed more consistent scales from the Olympics' tasks by excluding tasks that lowered the score consistency. For grades 5–8, two scales were built for humanities and mathematics. For grades 9–11, an additional science scale was identified. The core of this scale was formed by biological tasks, as most physics tasks loaded on the mathematical scale.

### 5.2. Olympics achievement and cognitive abilities

With the exception of ninth-grade, mathematical achievement correlated significantly with APM test scores. The correlations ranged from $r=.26$ to $r=.37$, where the correlation was $r=.11$. The $n$-weighted average was $r=.30$, $p<.01$.

The Unusual Uses Test did not show any significant correlation with mathematical achievement. The correlations ranged from $r=-.03$ to $r=.05$. The results are shown in Table 2.

For achievement in the humanities' nomination, the situation was different. Its correlations with APM ranged from $r=.05$ to $r=.34$, with the exception of eleventh-grade, where the correlation was $r=-.25$. This negative correlation lowers the $n$-weighted average to only $r=.07$. If the data for eleventh-graders is excluded, the $n$-weighted average reaches the value of $r=.15$.

The Unusual Uses Test had insignificant correlations of $r=-.06$ and $r=.02$ in grades 7 and 8 and significant correlations from $r=.14$ to $r=.42$ for the other grades with achievement in humanities. The $n$-weighted average is $r=.21$. The correlation of cognitive ability scores with achievements in humanities is shown in Table 2.

### 5.3. Estimation of range restriction

Olympics of the mind participants come from a selected sample. We estimated whether or not there was a range restriction on intelligence. The standard deviations and means of the APM are presented in Table 3. The Cronbach's $\alpha=.83$ for this test.

We have also collected data for an unrestricted sample of 8–10-graders in ordinary Moscow schools. The data are presented in Table 4.

The standard deviations of the research sample and the unrestricted sample were compared with Levene's Test on Equality of Variances. For 8th and 9th grades, there was no significant deference ($p=.11$ and .39 respectively). The difference was only found in 10th grade 10 ($p<.02$). However, the means differ significantly, $p<.001$ for all grades.

### 5.4. Comparison of the Olympics identification system and ability assessment

Since Olympics and ability assessment are considered different methods of identifying giftedness, it is interesting to assess how congruent their results are. Of course, the number of identified subjects, using either method, depends on threshold. For example in order to identify giftedness using intelligence testing, the threshold can be set at 130, or 125, or 140 IQ points. In each case, the number of identified gifted subjects will be different. Likewise, the number of gifted participants identified, because of their Olympics' score, may vary. In the subsequent analyses, four different methods were used to construct a sample that consisted of 10% of all participants considered most gifted according to the corresponding identification approach.

**Table 3**
The APM means and standard deviations in the Olympics sample.

| Grade | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|
| *N* | 73 | 105 | 80 | 89 | 120 | 109 | 135 |
| Mean | 20.4 | 22.4 | 23.3 | 24.0 | 24.9 | 25.4 | 26.5 |
| Std. Deviation | 5.7 | 6.1 | 5.5 | 5.6 | 5.7 | 4.8 | 4.9 |

1. With intelligence score— 10% of most intelligent participants were considered as gifted sample.
2. With intelligence plus creativity— intelligence and creativity scores were $z$-transformed and their sum was calculated for each participant. Again, 10% of participants with the highest sum were assigned to the gifted sample.
3. With total Olympics score— 10% of participants who had highest overall Olympics' score were assigned to the gifted sample.
4. With mathematics plus humanities scores— 5% of participants who had highest score in mathematics, plus 5% of participants who had highest score in humanities were considered gifted sample.

The intersections of the samples identified as gifted by Olympics and psychological assessment were calculated and presented in Table 5.

If the identification methods were not correlated, the intersection would be 10%. If the methods were completely congruent, the intersection would be 100%. Apparently, though intersections exceed the 10% level, they are far from the 100% level.

### 5.5. Abilities, achievements, and adaptation

Cronbach's $\alpha$ for frustration, anxiety, and loneliness scales were respectively .63, .54, and .74. Intelligence and creativity did not show significant correlations with personality traits. However, with highly intelligent boys in the tenth- and eleventh-grades (highest scoring half of the distribution) we discovered significant positive correlations between mathematical Olympics' achievement and loneliness problems ($r=.42$, $p<.05$ and $r=.30$, $p<.05$ for tenth- and eleventh-grades, respectively).

## 6. Discussion

### 6.1. Ability tests as Olympics' achievements predictors

The correlation of intelligence tests with Olympics' achievement is lower than usual correlations with both academic achievement and professional success. The correlations of intelligence with academic achievement are typically in the range of $r=.50$–.60. In our research, the correlation of APM scores with mathematical tasks was approximately $r=.30$.

One possible explanation for this low correlation is that the sample was selected from previous competitions and, thus, substantial range restriction can be expected. It could be a case of indirect range restriction: the sample was selected on problem solving in the previous

**Table 2**
Correlation of cognitive ability scores with mathematical achievement and (in brackets) achievement in the humanities.

| Grade | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|
| *N* | 73 | 105 | 80 | 89 | 120 | 109 | 135 |
| APM | $.37^{**}$ (.10) | $.36^{***}$ (.17) | $.26^{*}$ (.05) | $.36^{***}$ (.12) | .11 (.09) | $.30^{**}$ ($.34^{***}$) | $.36^{***}$ ($-.25^{**}$) |
| UUT (fluency) | .01 ($.35^{**}$) | −.04 (.14) | .00 (.02) | −.03 (−.06) | −.03 ($.25^{**}$) | .05 ($.42^{***}$) | .02 ($.30^{***}$) |

$^{*}$ $p<.05$.
$^{**}$ $p<.01$.
$^{***}$ $p<.001$.

**Table 4**
The APM means and standard deviations in the unselected sample.

| Grade | 8 | 9 | 10 |
|---|---|---|---|
| *N* | 36 | 48 | 103 |
| Mean | 15.4 | 20.4 | 19.7 |
| Std. Deviation | 4.2 | 5.6 | 6.0 |

'selection round' that is expected to correlate with both problem solving in the 'final round' and intelligence. Unfortunately, we don't dispose of the participants' results from the selection round. However, to address the range restriction problem we can compare intelligence scores from our research sample and from an unrestricted sample of some Moscow schools. The results of this comparison are rather unexpected. As expected, the intelligence means in the research sample are at least one standard deviation higher than in the unselected sample. But contrary to these expectations, the standard deviation was significantly higher for the unselected sample, only in tenth-graders (see Tables 3 and 4).

Significantly higher intelligence scores in our sample suggest that selection criterion (problem solving in the selection round) correlates with intelligence. If we estimate this correlation at $r = .30$, our sample should be about 3 standard deviations higher in problem solving in the selection round than average. If we estimate this correlation at $r = .50$, the sample should be 2 standard deviations higher in the selection round than average. This second estimation may seem more plausible, as it corresponds to about 5% of the initial participants who managed to reach the final round. However, it should be taken into account that the initial participants were already pre-selected by their decision to participate in the competition. It is plausible that highly motivated subjects who decided to participate in the competition are above average in both intelligence testing and Olympics' problem solving.

Our sample involves two criterions: 1) Subject's decision to participate in competition. 2) Solving Olympics' problems. This analysis probably explains why the sample selection doesn't necessarily cause range restriction. Of course, problem-solving selection should result in range restriction, but selection based on a subject's decision may lead to an opposing result if a disproportional number of highly able subjects penetrated into the sample. The combination of the two criterions may in fact produce an above average sample without range restriction.

Another explanation for a relatively low correlation is that some Olympics' participants have better opportunities for preparation than others. Some schools offer much better preparation than others. The Olympics gather children from many different schools, and their performance depends strongly on school conditions that may lower the impact of their abilities. The situation is similar with sports, where the technologies available for preparation are often worth more than the physical potential of the athlete. In contrast, when correlations of intelligence with school achievement are measured, usually schoolchildren who have studied together and consequently have similar possibilities to acquire competence and knowledge are assessed.

### *6.2. Olympics' results as a method to identify giftedness*

Our research has shown some discouraging results regarding the psychometric properties of Olympics score scales. The scales did not show high consistency and do not correspond directly with the results of the factor analysis. Some additional psychometric work is needed to convert Olympics' results into more or less psychometrically correct scales. This result is not completely unexpected because specialists in the relevant subject matter, not specialists in psychometrics, construct Olympics' tasks.

One could argue, the Olympics do not test for one isolated cognitive or personality trait, but is rather used for identifying giftedness as a whole, as a constellation of different psychological traits. Of course, life performance seldom depends on just one psychological trait. Olympics' victories, as real-life creative successes, derive from many different factors.

Consider a sports analogy. Good potential for a basketball player includes characteristics such as: height, good hand–eye coordination, quick reflexes, speed, strength, endurance, etc. These can be called first-order characteristics. Second order skills, like field shooting, performing lay-ups, rebounding, dribbling, etc. are developed by building on the first-order characteristics. The mastery of basketball constellates all of these skills.

Now imagine two ways to predict the potential of an elementary basketball player. The first would consist of carefully measuring first-order characteristics and applying them to basketball professionals. The characteristics that significantly predict professional capacity would be used as indicators to determine an elementary player's potential. This method is the analogue of the psychometric approach to giftedness identification, in the sense that it isolates first-order characteristics and determines their linear combination as the predictor for future performance.

The second way would involve assessing a beginner during a competition that more or less resembles a professional competition. This method is an analogous attempt to identify intellectual giftedness through Olympics of the mind. In this case, one cannot seek consistency because the competition includes events that do not necessarily correlate with one another. For example, free-throw ability does not necessarily correlate with ball-stealing ability, but both are important for basketball mastery.

Both ways have advantages and disadvantages. In its current form, the psychometric approach is unable to account for non-linear predictions of real-life performance. To continue with the basketball analogy, it is probable that the potential of a basketball player is a very complex interaction of characteristics like height, hand–eye coordination, speed, etc. Moreover, a player with a certain set of skills might perform better in one position than in another (e.g., guard rather than forward) and on a particular team where his or her strengths will contribute the most. Non-linearity cannot be usually accounted for by current methods of predicting real-life performance. Nevertheless, linear effects are strong enough to predict an important part of performance variance. Even intelligence as a single predictor can explain up to 50% of the variance in professional performance (Gottfredson, 1996).

The problem is different regarding the Olympics. There are no decisive arguments to postulate that performance in Olympics' is isomorphic to scientific activity. Further, it has been argued that the Olympics favor "intellectual sportsmen," people who can concentrate on solving difficult problems quickly, rather than find profound solutions for problems that require more time.

Olympics' success reflects competencies in solving complex academic problems that in turn depend on one's ability, personality, family support, school opportunities, etc. The question is whether or not factors involved in Olympics' competencies are relative to real-life performance. If they are, the Olympics can be a good predictor of research validity.

Some of these factors, such as superior intelligence, are stable and contribute to acquiring Olympics, as well as research, competencies. Yet, other factors are instable, e.g., school support. A good school can supply a student with ample resources for complex problem solving, in order to obtain good Olympics' results. A student's family can also influence the development of competencies, but it is unclear whether or not this influence is sustained through adulthood. Anyway, major environmental changes can occur between the time an adolescent

**Table 5**
The intersections of the different ways to identify giftedness.

| Identification method | IQ (%) | IQ + creativity (%) |
|---|---|---|
| Total Olympics | 25 | 23 |
| Math + humanitarian Olympics | 20 | 15 |

participates in the Olympics and the moment she or he begins professional research.

According to our data, the part of Olympic success that can be predicted by psychological instruments, such as intelligence and creativity tests is modest. Of course, we were only able to use a very narrow repertoire of psychological tests, but those we used seemed to be the most relevant for the purpose. We cannot exclude the possibility that some other personality traits, like introversion, could also influence Olympics' results, but it does not seem plausible that these factors can radically change the level of explained variance.

Regardless, winners of both the national and international Olympics must be intelligent and creative. When selection is made on a national level, even a moderately correlated measure will still successfully identify superior intellect. By selecting, say, 0.01% of the population, the Olympics succeeds in identifying those belonging to the highest 5%. Campbell's results are compatible with such a view. However, the Olympics may not have the same level of success in selecting a substantial number of gifted individuals.

### *6.3. Participation in Olympics of the mind as a life event*

The Olympics are more than just a method for measurement; they are also an important life event (Omdal & Richards, 2008). The course of participants' lives, especially with regard to career opportunities, can be positively and strongly influenced by prior Olympics' participation. Arguably, success in the Olympics is a "self-fulfilling prophecy." It is possible for a person to shape his or her environment in a way that encourages the progress of scientific activity. In this case, the predictive validity of the Olympics may even be higher than expected because of its influence on real-life events.

The Olympics of the mind have another important virtue compared to psychological testing. One's Olympics' score clearly depends, not only on ability, but also on individual efforts to acquire academic knowledge, which motivates children to work hard and succeed. In contrast, ability assessment leads to a more complex situation. As Dweck and Molden (2005) state, a subset of children and their parents perceive intellectual abilities as constant, and an unfavorable assessment can induce a kind of "stigmatization". While failure in the Olympics can be attributed to lacking effort, low results on intelligence tests are often linked to an inherent personal trait.

However, the results show one more side of Olympics' achievement — its connection with the previously mentioned loneliness problem in gifted individuals. It is widely accepted that prodigies, especially mathematical prodigies, often have problems communicating with other people (e.g., Wiener, 1956). Two explanations for this have been postulated. First, communication problems may be due to high intelligence, in which social skills are intrinsically compromised. Second, prodigies' communicative abilities are not trained enough because of their high investments in very abstract academic fields. Our evidence does not support the first explanation, as no correlation has been discovered between intelligence and personality scales. Of course, our sample was pre-selected — the participants were, in general, academically successful pupils. Underachieving gifted students were not among our subjects. Within this category, intelligence can probably be a negative adaptation factor. This result coincides with studies showing no special emotional and social problems (Freeman, 2001) or even the existence of special coping resources (Khasova, 2002) in gifted children. The data provides support for the second explanation. It has been shown that with highly intelligent boys, a significant correlation exists between mathematical Olympics' achievement and loneliness. Boys in general have better results in mathematics, and invest more in enhancing mathematical comprehension and application, which may hinder the development of social and emotional growth.

This evidence also indicates the importance of the fact that outstanding achievement in the Olympics requires intensive work, commitment, and investment of cognitive resources in abstract academic fields. Such investments are not as favorable for the development of social abilities. If social abilities are considered an important source of creative life, then the early specialization necessary for participating in the Olympics is probably not suitable for real-life creative achievements.

### *6.4. The academic specialization problem*

Resources for time and effort are limited among people, and devotion to an academic field inevitably takes away from other spheres of an individual's life. Our data shows that good results in the Olympics are achieved by means of important investments and concomitant academic specialization. The eleventh-graders are the most specialized in some academic fields, as they are about to enter higher education with a professional specialization. In this grade, a zero correlation ($r = -.02$) was found between humanities and mathematical results. Verbal creativity in eleventh-graders was not related to mathematical achievement ($r = .02$). Finally, a strange correlation of $r = -.25$, $p < .05$ was found between APM score and humanities Olympics' score. To sum up, the results show no link between humanities and mathematical achievement and no link or negative links between a verbal ability measure and mathematics and a performance ability measure and humanities, respectively.

## 7. Conclusion

Olympics' tasks form low consistency scales. Success in the Olympics often depends on the training children have received for the competition in their schools or elsewhere, which, in effect, may lower the impact of their abilities on their results. At the same time, participation in the Olympics can be a positively fulfilling experience in a participant's life and can influence career choices later on. Thus, the Olympics serve a purpose beyond identifying gifted adolescents.

Research evidence that is convincing for scientists is often not as impressive for the public or decision makers. The Olympics' tasks have very good face validity; its' complexity and novelty attracts gifted adolescence and intrigues the public. The Olympics of the mind as a tool for identifying giftedness, compared to psychological testing, has a better public image, but probably a more controversial scientific background.

## Appendix A. Sample marathon tasks for 11-graders

### *A.1. Mathematics*

Number $2010^{2010}$ was divided into several summands; each of them was later cubed, then summed and this sum was divided by 6. What is the remainder?

### *A.2. Humanities*

The following two extracts are from A.N. Ostrovsky's, "Dowerless Girl" and A.P. Chekhov's, "The Cherry Orchard". Succession of the characters' lines has been changed. Restore the succession. Which extract is objectively harder to do? Why?

### *A.3. Biology*

How does the existence of a third superfluous chromosome (in addition to a homologous pair) cause serious problems within the way an organism functions? Please note that the same "working" genes can be found in a normal diploid organism.

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