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Do Russian and American normal adults perform similarly on neuropsychological tests? Preliminary findings on the relationship between culture and test performance

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Abstract

To learn how culture may affect neuropsychological performance, eight tests were administered to non-brain damaged adult volunteers in the United States and Russia. The tests included Ruff Figural Fluency Test (RFFT), Color Trails Test (CTT), Digit Span Forward and Backward, and Category Fluency Test. Verbal and Visual Memory measures and Blind Clock Test were selected from Luria's (1980) battery. Forty-two Russian and 42 American volunteers (age 18–44) were assessed. It was hypothesized that the American group would outscore the Russian on timed measures (RFFT & CTT) due to cultural differences in familiarity with timed testing procedures. Otherwise, significant differences between the two groups were not expected to emerge. Consistent with the hypotheses, significant effect of culture was found on CTT and RFFT in favor of the American group. ANCOVA suggested that intergroup differences were not fully explained by differences in subjective relevance of the tasks to culture-specific experiences. The rest of the tests appeared similar for potential application in both cultures.

Keywords: Cross-cultural neuropsychological assessment; Cultural differences; Lurian approach

1. Introduction

The effect of cultural environment on mental processes investigated by Vygotsky and Luria in the 1930s remains largely opaque for neuropsychologists in the 21st century; it is still unknown how current models of brain–behavior interaction apply in different cultural contexts (Puente & Agranovich, 2003). In the last decade or so, an increasing number of publications have addressed the relevance of cultural factors to the performance on neuropsychological measures. Among such factors are time perception (Perez-Arce & Puente, 1997), attitude toward testing (Ardila, 2001; Puente & Perez-Garcia, 2000), values and meanings (Ardila, 2001), modes of knowing (Ardila & Moreno, 2001; Greenfield, 1997; Luria, 1979), and patterns of abilities (Ardila, 1995, 2001; Puente & Perez-Garcia, 2000). It has been demonstrated that cultural differences affect lateralization of language and spatial disturbances (Ardila, 1995), and have a profound effect on nonverbal behavior, language, and assumptions regarding causality (Marlowe, 2000). Recent research has also demonstrated that cultural experience, literacy level, quality of education, and degree

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of acculturation (Manly et al., 1998; Manly, Touradji, Tang, & Stem, 2003; Marcopulos, McLain, & Giuliano, 1997) influence neuropsychological test results.

Furthermore, according to Golden and Thomas (2000), culturally different individuals may approach problems with different functional systems. Here, the notion of "functional system" implies that a specific brain function is not localized in a specific area of cerebral tissue, but is distributed in a constellation of cooperating zones of the cerebral cortex and the subcortical structures (Luria, 1966/1980). Each of the brain zones contributes to the execution of a mental function according to its own individual characteristic, and the same brain area may "belong" to several different functional systems and take part in different higher mental processes. Thus, an execution of a particular cognitive task might require involvement of different constellations of brain structures, depending on relevance of the task to one's cultural background (Golden & Thomas, 2000).

Ardila (2001) suggested that cultural values involved in assessment procedures that are common in the Western world could be viewed as absurd by members of different cultural groups. For example, he argued that a Westerner would assume that the examiner has an authority to ask personal questions and provide rules during the assessment, and an examinee assumes that he/she is expected to perform at one's best and fastest. It is neither necessary nor common that these assumptions are shared by members of other cultural groups. According to Ardila, culturally diverse individuals might have difficulties with a stereotyped mode of communication that is usually utilized during the assessment. Furthermore, they might be extremely uncomfortable answering some questions due to possible differences in subjective concepts of private information. Therefore, it is important to take cultural variables into account at each stage of a neuropsychological evaluation, including review of the records, interview, test selection, and administration, as well as the interpretation of the results (Ardila, 1995; Ardila & Moreno, 2001; Golden & Thomas, 2000; Puente & Perez-Garcia, 2000).

The present study is an attempt to explore the effect of the culture-specific factors on neuropsychological performance in Russian and American adults. The choice of these two cultures was justified by several points. First and foremost, although both Russia and the United States have strong schools and history of neuropsychology, the approaches to assessment have traditionally been quite different. The major differences is thought to be between North American quantitative, psychometric approach versus qualitative, individualized methods of assessment developed by Luria (1966/1980) that are predominantly utilized in Russia (see Tupper, 1999 for a comparative review of the two approaches). In the recent decades, there has been an increase in collaboration between American and Russian neuropsychological schools (e.g., Glozman & Tupper, 1995) and the mutual influence has become more and more apparent. Thus, Luria's theory has been gaining more popularity among Western neuropsychologists, whereas in Russia, neuropsychologists are trying to adapt North American tests and incorporate them in the existing assessment batteries (e.g., Khomskaya, 1995). This collaboration appears fruitful and beneficial for individual patients and neuropsychology as a discipline. However, the empirical interface between these two cultures has yet to be pursed. Specifically, at present, no study has been conducted to investigate if cultural background would affect performance of Russian and American individuals on neuropsychological tests. Such a study would be of value in order to determine the equivalence of the two distinct methods of assessing brain functions neuropsychologically.

Review of limited literature on time attitudes in Russian culture suggested that attitudes to time may differ from those common in North American culture. Thus, such concepts as timeliness, promptness, adherence to deadlines, and time efficiency are not generally as relevant or not as well developed among Russian people as they are in American culture (Tongren, Hecht, & Kovach, 1995). For instance, in contrast with the American educational system, the school system in Russia has not historically utilized timed tests. Oral exams prevail over written tests, and it has been common to provide extra time upon request to finish an assignment. Therefore, people in Russia are not generally as concerned with completing the assignments or tests quickly and/or on time. This pattern is also reflected in neuropsychological assessment. For example, in one of the major Russian handbooks of neuropsychological assessment (Vasserman, Dorofeeva, & Meyerson, 1997), it is suggested that the speed of testing must be individualized and one should not require that a patient be fast working on a task—a far cry from standardized North American approaches.

Thus, the goals of the present study were (1) to investigate whether differences in performance on neuropsychological tests exist between American and Russian samples, and (2) to identify tests from both standardized American and Lurian "qualitative" approaches for which there are no significant differences due to cultural variables.

Table 1
Demographic variables for American and Russian samples

	N	Males	Females	Age [Mean (*SD*)]	Education [Mean (*SD*)]
USA	42	21	21	28.95 (8.88)	13.68 (1.83)
Russia	42	21	21	29.15 (6.90)	14.25 (2.06)

1.1. Hypotheses

First, it was expected that the American group would do better on timed tests, the difference being due to culture-bound attitudes toward timed performance as well as greater familiarity with timed procedures in American adults as compared to Russian participants. Secondly, it was anticipated that the Russian subjects might place less importance than Americans on completion the tasks as quickly as possible, and/or would find the tasks less relevant to their everyday experience. And finally, given that the tests and methods used in the present study were carefully selected for cross-cultural application, it was expected that the American and Russian samples would not differ on measures that were not speed sensitive. In turn, this comparison would suggest the appropriateness of different tests for use across these two cultures.

2. Method

2.1. Participants

The tests were administered to 84 American and Russian right-handed adult volunteers, with no history of brain injury or psychiatric disorders (descriptive statistics are presented in Table 1). Volunteers for the American sample were recruited among undergraduate students at UNC Wilmington and residents of the state of North Carolina via local advertising and a word of mouth. The Russian sample was recruited from several Moscow universities and from the non-college population in Moscow and its surrounding region via similar methods in collaboration with our colleagues from the Department of Psychology of the Moscow State University. Each cultural group was equally represented by both sexes. Participants' education levels ranged from high school to a university degree. The groups were closely matched for age, gender, and educational background. Also, to compensate for the differences in length and content of high school education, 2 years were added to the total number of years of education completed for each Russian participant.[1]

A sample size of 39 subjects per group was suggested as sufficient to obtain high-power results. The resources allowed for recruitment of 42 participants per cultural group, which provided for sufficient power associated with our findings. We had to exclude two participants in each of the groups due to missing data in their test results. Each participant understood and signed an Informed Consent Form in the participant's native language prior to the test administration.

2.2. Test selection criteria

Careful selection of the testing instruments for application across cultures is essential (Ardila, 1995,2001; Puente & Perez-Garcia, 2000). Thus, Helms (1997) suggested that to control for cultural bias in neuropsychological assessment, the tests ought to be matched according to (1) functional equivalence, that is the extent to which the test scores have the same meaning in different cultural groups and measure the same psychological constructs with equal accuracy within these groups; (2) conceptual equivalence (level of familiarity with the test items); (3) linguistic equivalence, that is the extent to which the language used in the tests has equivalent meaning across cultural groups; (4) psychometric equivalence, or the extent to which tests measure the same thing at the same level across cultural groups; (5) testing

[1] The average length of high school education in Russia is 10 years, compared to 12 years in the United States. However, according to the World Evaluation Center in the United States, the content and number of academic hours are equivalent to the North American standards and high school diplomas are comparable.

condition equivalence; (6) contextual equivalence, that is the evidence that the cognitive ability being assessed is comparable across environments; and (7) sampling equivalence, that is that the samples of subjects representing cultural groups should be comparable.

We attempted to address the most of these criteria in the present study, choosing tests and test item considering their appropriateness in both American and Russian cultures. The sampling equivalence was addressed by closely matching the groups, as described above. Furthermore, following the suggestions from literature on cross-cultural research, the selected tests were short and easy to administer, and sampled a relatively large range of cognitive abilities. The measures were accurately translated according to cognitive rather than linguistic equivalence. Thus, the items and instructions that were originally developed in English were translated to Russian independently by two bilingual Russian-English speakers, for whom Russian is the native tongue and who are familiar with Russian culture. Subsequently, the items were back-translated to English by a bilingual individual whose native language is English to ensure that translation is as precise as possible. The same procedure was used for the instructions to the tests that were originally developed in Russian and subsequently translated into English. Any discrepancies in translation were addressed to match the measures according to conceptual, functional, and metric equivalence. In addition, to minimize problems with translation and ensure conceptual equivalence, the measures were pre-tested on eight bilingual Russian Americans residing in the state of North Carolina.

In addition, words used in verbal tests were matched for length and frequency. To account for that, frequency dictionaries for both Russian and English words were employed (Carroll, Davies, & Richman, 1971; Dahl, 1979; Zasorina, 1977). One of the authors, who is a native Russian, along with the bilingual and bicultural interpreters, reviewed the test items for appropriate cultural content with regards to the intentions of each item.

The short screening test battery included tasks from both North American (standardized) and Russian (based on Lurian syndrome analysis) methods of evaluation of higher mental functions. Inclusion of both approaches served several purposes. The Lurian diagnostic procedure is thought to be an effective assessment for relationship between behavior and culture (Golden & Thomas, 2000; Nell, 1999; Tupper, 1999). According to this approach, which is flexible and qualitative in nature, neuropsychological assessment is carried out to describe impairments in higher mental functions by identifying underlying impaired factors or disturbed links in the functional systems. On the contrary, standardized American tests provide valid norms to compare individual performance. And finally, the combination of the two approaches allows for more comprehensive analysis of cognitive functions in different cultural groups (Glozman & Tupper, 1995). Also, as noted by Tupper (1999), development and standardization of the new tests consistent with the Lurian theoretical approach "is expanding the traditional scope of cognitive assessment beyond a purely psychometric perspective" (p. 60). Thus, eight tests were selected for the study; a rough classification of the tests according to the brain area primarily involved in performance on each task is presented in Table 2.

The following tests were selected from American standardized instruments:

1. Color Trails Test (CTT).

   Trail making tests are among the most widely used measures in neuropsychological practice (Mitrushina, Boone, & D'Elia, 1999). The most recent of them is the CTT (D'Elia, Satz, Uchiyama, & White, 1994), which reportedly allows broader application to cross-cultural studies compared to the original Trail Making Test A and B, at the same time being similar to it in terms of neuropsychological sensitivity. CTT was developed as a measure of attention and concentration in individuals 18 years of age and older. The respondent must be able to recognize Arabic numerals and

Table 2
Classification of the selected neuropsychological measures

Hemisphere	Area of the brain primarily involved in the task	
	Anterior	Posterior
Left/verbal	Verbal Fluency Test[a]	Digit Span Forward[a]
	Digit Span Backward[a]	Verbal Memory Test[b]
Right/visual	Ruff Figural Fluency Test[a]	Visual Memory Test[b]
	Color Trails Test[a]	Blind Clock Test[b]

[a] Standardized North American tests.
[b] Tests derived from Luria (1966).

distinguish between pink and yellow colors. It is suggested that even if an individual is colorblind, he or she would still be able to detect the difference between colors on the basis of darkness, and hence to complete the task (D'Elia et al., 1999). The test consists of two parts, and the score represents the time in seconds spent to complete each part.

2. Category Fluency Test.

   Commonly applied in assessment of frontal functioning in the Western world, the test has its analogs in the Lurian scheme of neuropsychological evaluation (see Glozman, 1999; Luria, 1980, 1999). Performance on verbal fluency tasks depends on several factors including short-term memory, ability to initiate and maintain response, cognitive flexibility, and response inhibition capacity (Lafleche & Albert, 1995; Luria, 1980; Martin & Fedio, 1983). These functions are usually referred to as "executive" and associated primarily with the left frontal area of the brain (Benton, 1968; Milner, 1964). The most commonly applied version of verbal fluency test in English-speaking countries is FAS and CFL (Spreen & Benton, 1969), where a subject is asked to name as many words as possible that begin with letter "F" or "C" in 60 s, the same procedure is repeated for the other two letters. To avoid issues that could arise due to differences in frequency of the words with a certain first letter and/or length of words in Russian and English, Category Naming version of the test was applied. Thus, Animal Naming test (Rosen, 1980) was used, where the participants were to name as many different animals as they could in 1 min. Two test scores were collected: (1) total number of different animals named in the allocated time, and (2) number of perseverative errors made.

3. Digit Span Forward and Backward.

   This test is a part of WAIS-III (Wechsler, 1997), which is most widely used in North America for assessment of psychological and neuropsychological functions (Camara, Nathan, & Puente, 2000). Both subtests consist of seven pairs of random number sequences read to the examinee, and he/she is required to reproduce the sequences either in the same order (Digit Forward) or in the reverse order (Digits Backward). The Forward Span is primarily a measure of efficiency of attention, whereas the Backward Span tests the mental tracking and working memory (Lezak, Howieson, & Loring, 2004). It appears that the test in its entirety is easily translatable and appropriate for a variety of cultures assuming a certain level of literacy.

4. Ruff Figural Fluency Test (RFFT).

   RFFT (Ruff, 1996) was chosen as a measure of nonverbal fluency analogous to the verbal fluency tests. It requires the respondent to generate as many different designs in a set period of time (1 min) by connecting patterns of dots. The test was developed as a measure of nonverbal capacity for fluid and divergent thinking, ability to shift cognitive set, planning strategies, and executive ability to coordinate this process (Ruff, 1996), and has been proved to be sensitive to right frontal lobe impairment. It also appears to match the requirements for culturally appropriate methods of assessment, as it is short, easy to administer, and does not require any specific skills or knowledge that would differ significantly across cultures. There were two scores used for this test: (1) total number of unique designs created, and (2) error ratio, which is a ratio of total number of errors and total number of unique designs.

In addition, the following tests were selected from Luria's neuropsychological evaluation (1966/1980, also see Luria, 1999, for English version):

1. Verbal Memory Test (Word List).

   The variations of this test are being commonly used for assessment of left temporal functions in many countries. A set of 10 words was used; the words in the set were selected and matched according to both frequency and length of words in Russian and English. Word frequency data were obtained from the respective language dictionaries (Carroll et al., 1971; Dahl, 1979; Zasorina, 1977). A total number of correctly recalled words over five consecutive trials and the number of perseverative errors were recorded.

2. Visual Memory Test.

   An original test from Luria's battery (reprinted in Khomskaya, 1987), this task is associated primarily with functioning in the posterior areas of the right cerebral hemisphere and requires to recall five difficult-to-verbalize figures after a short exposure. Although the test was developed in the Soviet Union, the items in the test appear to be equally abstract for both English and Russian speakers, and not resemble any culture-specific symbols or signs for either of the cultures. The administration procedure was as described in the original battery (Luria, 1980, 1999; Khomskaya, 1987).

3. Blind Clock Test.

In this test, 10 pictures of clocks with no numbers were presented, one picture at a time, and the subjects were asked to tell what time was shown on the clock. This task utilized stimuli from the neuropsychological test booklet derived from Luria's battery (Khomskaya, 1987). The test is considered to be a valid measure of visual-spatial functions (Luria, 1980).

2.3. Post-testing questions

In addition, a short screening measure of cultural attitudes was developed for this study (i.e., Post-Test Questionnaire). To determine whether such factors as familiarity with testing procedures, importance of the fast performance on the tests, and relevance of the tasks to participant's everyday experience could affect the test results, each participant was asked to answer three post-testing question using a 1–7-point Likert-type scale. Upon the completion of the tests, each participant was to grade (1) how interesting did they found the tasks to be, (2) how relevant were the tasks to their real-life experience, and (3) how important was it to complete each of the tasks quickly.

2.4. Procedure

The tests were administered individually in a quiet and comfortable atmosphere by the senior author (for the American sample) or a Russian psychologist trained in neuropsychological assessment (for the Russian sample). Each volunteer completed the battery in 30–40 min. To avoid the order effect, the sequence in which the tests were administrated was randomly varied from volunteer to volunteer. To find out possible impact of familiarity with testing procedures and attitudes toward testing on test performance, upon the completion of the tests each participant was given Post-Test Questionnaire described above. The participants were debriefed regarding the purpose of the study and were presented with an opportunity to discuss their results with a qualified coinvestigator.

2.5. Scoring

The development of scoring criteria in cross-cultural research represents a challenge, as the scoring system for Russian qualitative methods is far different from the one used in North America. For most of the tests (Digits Forward and Backward, Verbal Fluency Test, Verbal Memory Test, Visual Memory Test, and Clock Test) items were considered either right or wrong, with 1 point given for each correct and 0 for incorrect response. RFFT and CTT were scored according to the criteria described in the test manuals (see Ruff, 1996; D'Elia et al., 1994, respectively). In addition, qualitative analysis of mistakes was conducted according to guidelines suggested by Luria (1980). Hence, the "North-American" tests were scored according to their manuals or accepted methods as described in published sources, whereas the "Russian" tests were scored using the Luria method.

Given that no data were presented regarding the cultural equivalence of these tests, the approach taken here can only be viewed as exploratory or preliminary.

3. Results

The power analysis was conducted via GB-STAT, a statistical software program that allows calculation of power and sample size for various analyses. According to the program, the recruited sample size was sufficient for obtaining high-power results.

American and Russian samples were closely matched for sex, education, and age; therefore, no significant difference between the two groups was found (for age, $t\,(78) = 0.11$, $p = .9108$; for education, $t\,(78) = 1.32$, $p = .1909$). This made it possible to use raw scores instead of age- and education-corrected *T*-scores for further analysis. The results are presented and discussed from two standpoints: quantitative, in accord with the American paradigm, and qualitative, i.e., analysis of types of mistakes, which reflects the Lurian approach to analysis of neuropsychological performance.

T-tests comparing the means of the group scores were performed for each of the tasks. To control for family-wise Type I error (FW), α was adjusted using ordered Bonferronni procedure (Dunn, 1961), according to which the significance levels were ordered from the most to the least significant, and the desired level of FW = 0.05 was divided by a number of a particular comparison (one to nine, in this case). That is, the most significant result was compared

Table 3
Test results for American and Russian groups in term of descriptive statistics (mean, standard deviation, and range) and significance level (p) of the between group differences

Test	USA		Russia		p	
	M (SD)	Range	M (SD)	Range	Critical	Obtained
CTT 1 (s)*	26.08 (7.63)	13–46	38.30 (12.27)	21–91	.05	.0001
CTT2 (s)*	61.63 (19.18)	35–103	75.46 (22.63)	41–136	.025	.0042
Relevance*	5.05 (1.45)	1–7	3.98 (1.83)	1–7	.0167	.0047
RFFT Total Unique Designs*	114.80 (18.31)	68–144	103.40 (20.67)	63–149	.0125	.0108
Verbal Memory Total	41.65 (3.51)	31–47	43.50 (3.28)	34–49	.01	.0172
Digits Backward	7.83 (1.99)	4–14	6.75 (2.06)	3–11	.0083	.0199
Verbal Fluency Total	21.75 (3.48)	15–30	24.18 (5.87)	15–36	.0071	.0281
Digits Forward	10.58 (2.05)	7–15	9.70 (1.84)	5–13	.0625	.0481
Clock Test Total	8.55 (1.36)	5–10	8.83 (1.13)	6–10	.0056	.3278
Visual Memory Total	23.05 (2.36)	15–25	22.63 (2.58)	13–25	<.005	.4446
Interest	5.55 (0.90)	4–7	5.70 (1.45)	2–7	<.005	.5814
Speed	5.68 (0.80)	4–7	5.83 (1.47)	2–7	<.005	.5717

The results are presented in the order of statistical significance of the findings. Critical α-values are adjusted according to ordered Bonferronni procedure.
* Significant at adjusted α-level.

to $\alpha = .05$, the second most significant to $\alpha = .05/2 = .0025$, and so on, with the least significant result compared to $\alpha = .05/9 = .0056$). Overall results in terms of group means and standard errors, and significance level are presented in Table 3.

Data analyses revealed a significant effect of culture in performance on timed tests, such that the American group did significantly better on both CTT and RFFT. Thus, for CTT Part 1, $t(65.3) = 5.351$, $p = .0001$, and for Part 2, $t(78) = 2.953$, $p = .0042$. On RFFT, American group ($M = 114.8$, $SD = 18.31$) also significantly outperformed the Russian ($M = 103.4$, $SD = 20.67$), in that they created more designs in a given time, $t(78) = -2.611$, $p = .0108$. At the same time, on both CTT and RFFT, the Russian group made more errors compared to the American sample, but not significantly so. It is interesting to note that if norms for CTT validated for North American population were applied to the scores of Russian participants, the performance of the 27.5% of Russian sample would fall in the borderline to impaired range on at least one of the two parts; only one of the American participants scored in such low range. Whether these differences can be attributed to the lack of familiarity with the timed testing procedures in Russian culture is not clear and requires additional investigation.

The Russian group performed better on Category Fluency and Verbal Memory tasks (Table 3), but the difference only approached significance at the adjusted α-level. Thus, Russians on average, named more animals on Verbal Fluency Test, $t(63.5) = 2.248$, $p = .0181$, and recalled more words in Verbal Memory Test, $t(78) = 2.434$, $p = .0172$. Also, on average, the Russian group made significantly fewer perseverative errors in both the Category Fluency ($M = 0.28$, $SD = 0.51$) and Verbal Memory ($M = 0.78$, $SD = 1.61$) tests then did the American group (for Verbal Fluency: $M = 0.65$, $SD = 0.95$; for Verbal Memory: $M = 2.10$, $SD = 2.42$), $t(78) = 3.81$, $p = .0038$.

According to the ordered Bonferronni procedure, the differences in either Digit Forward, ($t(78) = -2.008$, $p = .0481$) or Digit Backwards subtests ($t(78) = -2.376$, $p = .0199$) were not significant. No differences between groups were found in performance on Visual Memory and Clock Tests (see Table 3). On the two latter tests, both groups made about the same number of mistakes and similar types of mistakes (omissions and rotations being the most common for both groups).

Although it was expected that the American volunteers would find it more important than would do Russians to complete each task as quickly as possible, there was no significant difference between groups in their response to Post-Test Questionnaire about that. Neither did the results differ for the interest scale (see Table 3 for statistics). At the same time, the Russian group rated relevance of the tasks significantly lower ($M = 3.98$, $SD = 1.83$), than did Americans ($M = 5.05$, $SD = 1.45$), $t(78) = -2.910$, $p = .0047$. Analysis of covariance, however, suggested that intergroup differences were not fully explained by differences in subjective relevance of the tasks to culture-specific experiences. That is, when controlling for differences in subjective ratings of relevance, there was still a significant main effect of culture for both RFFT and CTT.

4. Discussion

In accord with the proposed hypotheses, the American sample outscored the Russian one on timed tests, whereas the rest of the selected measures of neurocognitive functioning did not reveal significant differences between the groups. In general, these results support the hypothesis that, because time-based activities are not as widespread in Russia as in America, Russian volunteers may not necessarily be aware of the principle that "the faster, the better," and may simply take their time to complete the task. Alternatively, one could also argue that Russians may simply be slower, though not worse, than their American counterparts on at least these neuropsychological measures, although there are no data to support this viewpoint.

It is worth noting that CTT was selected for this study due to its reported "culture-fairness" (D'Elia et al., 1994; Maj et al., 1993). However, the results suggest that there might be a large variability in the performance on this test due to culture-bound factors. Thus, familiarity with testing procedures and relevance of the applied techniques to real-life experience could affect the task performance. This is but one example for the need to validate a test for each particular cultural group before applying existing norms across cultures. As emphasized by Nell (2000), there is a risk that "... identical tests may make geniuses of average people in one culture and imbeciles of equally average people in another" (p. 13), and thus lead to biased or misleading conclusions.

The most significant differences were found in performance on the timed tasks, CTT and RFFT, which were designed to assess the functioning of the anterior part of the right hemisphere and general integrity of brain function. In these tests, the American group outscored the Russian group. However, because we selected volunteers with no brain damage and performance on other tests was in normal limits in both groups, it appears unreasonable to attribute low performance of the Russian sample to problems with in attention, concentration, or planning strategies, which are being assessed by these tasks. Rather, the differences might reflect culture-specific effect of relevance of the assessed function to real-life experience. That is, lack of exposure to timed tests and rare occurrence of experiences where timed performance is required or measured in everyday routine of Russian people could provide a salient explanation for the observed group differences. Furthermore, these findings may provide additional support to the notion of cultural specificity of cognitive abilities put forward by Ardila (1995) and Greenfield (1997). That is, because Russian culture does not emphasize importance of timing one's performance, adhering to deadlines, and being prompt as much as does American culture, measuring cognitive performance with timed tests might be not as ecologically valid. That is, understanding the ecological validity of the neuropsychological tests is critical for valid interpretation of the results (Ardila, 2001; Shordone & Long, 1997).

The differences in performance on the verbal tasks such as Category Fluency, Digits, and Verbal Memory were not found to be significant, and further investigation with larger samples and broader range of verbal tests is necessary to further explore possible influence of language. The lack of findings on these domains in this study could also be sample specific. There were no significant differences on either Digits Forward or Backward, nor did differences exist on the Visual Memory and Blind Clock tests, suggesting that these tests may be appropriate for cross-cultural applications. To investigate that, however, it would be necessary to apply the tests using clinical samples.

The study presented an attempt to investigate the relationship between culture and neuropsychological performance and is exploratory in nature. At the same time, it is, to our knowledge, the first study that compares Russian and American samples using Russian and American neuropsychological measures. The results, although preliminary, once again illustrate that the existing tools of neuropsychological assessment are far from being universal. Cultural bias and inappropriateness of the majority of standardized, Western-culture-oriented tests and norms for evaluation of cognitive functions in individuals from different cultural background, as well as lack of attention to a variety of cultural factors can significantly affect the outcome of neuropsychological evaluation. That is why it is important to "keep culture in mind" (Cole, 1997) while conducting the research or providing clinical evaluations using a neuropsychological approach.

Although the aim of the present study was to study the nature of possible cultural differences in test performance in normal sample, the study of these effects in traumatic brain injury (TBI) population, could bring neuropsychologists closer to understanding of how different cultural contexts appear to affect the pattern of higher cortical functions. Thus, the replication of the study on Russian and American samples involving patients with TBI is in order to learn more about culture–brain relations.

Generally speaking, when studying relations between culture and brain, it is important to remember that "the job of science is to find the orderly relations among phenomena, not differences" (Sidman, 1960, p. 15). Furthermore, the foundation of cross-cultural or cultural neuropsychology should be the investigation of the existence of neuropsy-

chological "g" (Puente & Perez-Garcia, 2000). That is, if neuropsychologists are ever able to define common factors or cognitive mechanisms that are shared by all members of the human race, it may be possible to develop more "culture-fair" measures of cognitive performance. Meanwhile, attention must be focused on the revision and expansion of existing neuropsychological methods and on development of the normative comparative samples for non-Western cultural groups. To avoid this critical task will limit the generalizability of clinical neuropsychology to a more universal application and value.

When developing this project, we aspired to compare neuropsychological performance in normal adults across several cultures. However, due to feasibility issues, only two cultural groups were used in the present study. Also, the samples we were able to recruit were relatively small. Therefore, it appears that replicating the present findings using larger samples from a variety of cultural backgrounds would be in order.

The study attempted to assess cultural attitudes and their effect on the results of test performance; however, the post-test questionnaire used for this purpose was very brief, and it was difficult to make reliable inferences from its results. At the same time, the presence of the effect of culture in responses to some of these questions suggests that, if assessed in greater detail, culture-specific factors could provide an explanation of differences in approaches to and performance on neuropsychological measures. Despite these concerns, the present study underscores the importance of including culture in an active fashion in neuropsychological assessment. This paradigm shift appears to becoming a requirement as the demographics of the United States shifts to a highly heterogeneous cultural base and as neuropsychology begins to have increasing impact beyond Russia and the industrial Western countries.

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