The Russian Version of the Oxford Cognitive Screen:

Validation Study on Stroke Survivors

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We would like to acknowledge the contribution that Professor Glyn Humphreys made by inspiring many local clinical and scientific communities in different countries to pursue studies of cognitive assessment in neurological diseases. Professor Humphreys passed away on January 14, 2016 after fruitful discussions and consultations on the current project.

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Public Significance Statement: The present study describes the adaptation and validation of a stroke-specific cognitive screening tool called the Rus-OCS in a Russian speaking sample. Introducing this tool responds to the need of quantitative neuropsychological screening tools available in Russian. Our study provides a picture of post-stroke cognitive deficits which are not language-specific drawn from relatively large clinical sample (N = 205).

Social Media Post: We validated stroke-specific cognitive screen for Russian speakers and reported on the post-stroke cognitive deficits.

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Abstract

Objective: The Oxford Cognitive Screen (OCS) is a screening tool for the assessment of post-stroke deficits in attention, memory, praxis, language, and number processing. The goal of the present study was to develop a Russian version of the OCS (Rus-OCS) via translation of the original battery, its cultural and linguistic adaptations, and reporting preliminary findings on its psychometric properties. ***Method:*** All parts of OCS were translated by native Russian speaking neuropsychologists. 205 Russian speaking stroke patients were assessed with the Rus-OCS. Their performance was compared with performance of 60 healthy Russian speaking adults aged between 18 and 91 years. 15 stroke patients and 42 healthy adults were tested with a parallel version within 7 days of first testing. Convergent validity of the Rus-OCS was established via correlations with comparable tasks. Performance of three stroke groups with different lesion lateralisation (right, left, and bilateral) was compared on language and visual attention subtasks. Preliminary normative data based on 5th to 95th percentile were also reported. ***Results:*** Measures of internal consistency and test-retest reliability ranged from acceptable to very good, and estimates of convergent validity ranged from moderate to high. Sensitivity and specificity was found to range from .56 to 1 and from .73 to 1, respectively. Significant differences in performance between stroke and healthy groups on all subtasks confirmed the discriminative power of the Rus-OCS was good. ***Conclusions:*** Rus-OCS is a promising cognitive screening instrument for Russian speaking patients. However, further validation is needed. Constraints of socio-economic differences between Russian speakers in the wider population should be considered.

Keywords: cognitive testing; neuropsychological assessment; stroke; Russian; validation

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Stroke leads to a variety of cognitive deficits affecting the quality of life (Carod-Artal, Egido, González, & De Seijas, 2000), personal relationships (Thompson & Ryan, 2009), mood (Carson et al., 2000), activities of daily living and overall physical function (Lai, Studenski, Duncan, & Perera, 2002; Corbetta et al., 2015). In the case of minor stroke or transient ischemic attack causing relatively small lesions, there may be no obvious visible symptoms (Easton et al., 2009). However, severe lesions tend to result in a broader range of sensory, motor and cognitive impairments (Barker-Collo & Feigin, 2006), including memory, executive control, and language deficits as well as visuospatial neglect (Patel, Coshall, Rudd, & Wolfe, 2002; Moorhouse & Rockwood, 2008). Neuropsychological diagnostic tools can discriminate domain-general deficits (e.g., decreased executive control) from domain-specific ones (e.g. aphasia or visuospatial neglect), necessary for planning patients' cognitive rehabilitation (Cumming et al., 2013; Massa et al., 2015). Furthermore, individual profiles of cognitive impairments provide information for treatment planning (Cumming, Marshall, & Lazar, 2013) and predict recovery outcomes (Nys et al., 2005). Therefore, importance of having reliable and valid instruments for post-stroke cognitive screening cannot be overestimated.

Cognitive Screening in Stroke

Cognitive screening instruments require, at a minimum, acceptable reliability and validity. Most cognitive screening tests developed to detect dementia, such as the Montreal Cognitive Assessment (MoCA) (Nasreddine, et al., 2005), Mini-Mental State Examination (MMSE) (Bour, Rasquin, Boreas, Limburg, & Verhey, 2010) and Addenbrooke's Cognitive Examination Revised (ACE-R) (Morris, Hacker, & Lincoln, 2012), all have at least adequate validity and reliability. However, tests of cognitive decline are not necessarily valid for cognitive assessment following stroke (Dong et al, 2010; Pendlebury, Mariz, Bull, Mehta, & Rothwell, 2012). This is because dementia screening instruments do not consider in detail the limiting effects of post-stroke functional impairments to attention and language on test performance raising the likelihood that any residual cognitive strengths may be masked. This reduces the validity of a screening test for profiling potential cognitive functions following stroke (Demeyere, Riddoch, Slavkova, Bickerton, & Humphreys, 2015). For example, aphasia after stroke is often a constraint on performance when given neuropsychological tests despite preserved cognitive processing. Some screening tools include non-verbal subtasks to reduce such constraints on the performance of patients with language difficulties. However, extant instruments do not typically allow patients to provide non-verbal responses on all tasks. For example, on MoCA orientation task patients with expressive aphasia will score zero even when they can perform the task correctly with a nonverbal response such as pointing to the correct date on a calendar via forced choice. Similarly, a patient with visuospatial neglect may not attend to graphic stimuli presented in the neglected side of space despite preserved recognition of stimuli with attentional cues.

Current screening tools for post-stroke cognitive function are also limited by often exclusive assessment of one cognitive domain (attention, language, memory) without concurrent testing of domain general impairment using an equivalent and standardized format. Therefore, even if a test is highly reliable and valid, the results assess performance within a relatively narrow range of cognitive function, e.g. language (Kuzmina, Humphreys, Riddoch, Skvortsov, & Weekes, 2017). Assessment of intact and impaired cognitive function using a standardized test battery increases the sensitivity of a neuropsychological screening instrument. Ideally, tools will also be independent of language specific constraints to increase validity for use across cultures and socio-economic classes (e.g., Raven, 2000). The advantage of language independent screening tools is replicability across countries and cultures, thus providing an instrument with universal application for testing neuropsychological processing (see Kong et al., 2016, 2017; Kuzmina et al., 2017). Such a tool has advantages beyond simply neuropsychological diagnosis and rehabilitation in a world where cultural and linguistic diversity is increasing (Abutalebi & Weekes, 2014). Big data sets collected across cultures, ethnicities and languages are now shared for development of theories and treatments in a range of neurological disorders and in neuroimaging methods, e.g. in the ENIGMA project (Thompson et al., 2014).

Reviews of cognitive screening instruments (Cullen, O'Neill, Evans, Coen, & Lawlor, 2007; Hachinski et al., 2006; Dong et al., 2010) have identified several different types of diagnostic measures. *Brief screening scales*, including MoCA (Nasreddine et al., 2005), Neurobehavioral Cognitive Status Examination (Mysiw, Beegan, & Gatens, 1989), MMSE (Bour et al., 2010), ACE-R (Morris, Hacker, & Lincoln, 2012), Repeatable Battery for the Assessment of Neuropsychological Status (Wagle et al., 2011), the Cognitive Functional Independence Measure (Zwecker et al., 2002), and the Cambridge Cognition Examination (CAMCOG) (de Koning et al., 1998). These scales are time-efficient, have short administration (between 10-30 minutes) and can be used for inpatient admission and outpatient evaluations. However, a criticism of such scales is they do not classify the properties of a tested domain in detail using established terms derived from cognitive neuropsychology, e.g. the type of memory impaired (episodic versus semantic), the locus of language impairment (word or sentence), and auditory versus visual comprehension, nor do they test the limits of a cognitive process i.e. provide opportunities to demonstrate correct performance e.g., line drawing with apraxia.

In response to these limitations, *stroke- and aphasia-specific neuropsychological batteries* have been developed. These include the Birmingham Cognitive Screen (BCoS)

(Humphreys, Bickerton, Samson, & Riddoch, 2012), the Oxford Cognitive Screen (OCS) (Demeyere et al., 2015, 2016), the Cognitive Assessment scale for Stroke Patients (CASP) (Barnay et al., 2014), Western Aphasia Battery-Revised (Kertesz, 2006), Cognitive Linguistic Quick Test-Plus (CLQT™+) (Helm-Estabrooks, 2001) and the NINDS-CSN VCI neuropsychological assessment protocol (Han, Anderson, Jones, Hermann, & Sattin, 2014).

Although these instruments are more suitable for testing the limits of neuropsychological processes in stroke, one limitation of these instruments is that most of them have been validated on limited samples. Inclusivity, sensitivity and specificity of such instruments are therefore dependent on the size and type of clinical group. Ideally, a valid instrument will be sensitive to a wide range of neurological conditions. However, these instruments can help to identify the most important patterns of functional and cognitive abilities in any patient to form a unique profile for subsequent more detailed assessments (Cullen et al., 2007).

Questionnaires can be applied to a larger sample and a wider range of neuropsychological conditions. For example the Stroke Impact Scale (Richardson, Campbell, Allen, Meyer, & Teasell, 2016), the Telephone Interview for Cognitive Status (Barber & Stott, 2004), and the Informant Questionnaire on Cognitive Decline in the Elderly, or IQCODE (McGovern, Pendlebury, Mishra, Fan, & Quinn, 2016) are all reliable and valid self-report instruments. Abovementioned questionnaires also have validity, so they can be used in community care programs, and they can often be executed via telecommunication services online, by telephone, or by caregiver reports. However, subjective reports of informants are prone to human error, and interpretation could be limited by biases.

C*omputerized assessments* reduce human error and subjectivity. These instruments include OCS Plus (Humphreys et al., 2017), CogState Brief Battery (Maruff et al, 2009), Cambridge Neuropsychological Test Automated Battery (Égerházi, Berecz, Bartók, & Degrell, 2007), Cognistat Assessment System (CAS-II) (Mueller, Kiernan, & Langston, 2011) and others. Most of them are automatized adaptations of self-report and paper-and-pencil diagnostic tools, although the software also allows a deeper level of data analyses e.g. via deep learning to predict outcomes using objective measures such as motor speed, reaction time, eye tracking and EEG. In addition, online computation of testing improves the validity, reliability, sensitivity and standardization of instruments across different age groups, levels of education, and socio-economic status (Zygouris, & Tsolaki, 2015). Potential bias can occur in computerized assessment because of varying levels of computer literacy and use of technology (particularly in seniors), as well as learning effects that emerge in repeated measures (Parsons, 2016). It has also been argued that computerized assessments do not solve the core problem of ecological validity that characterize neuropsychological testing (though see Burgess et al., 2006). These problems aside, adaptation of big data, neural interfaces and virtual reality to neuropsychological screening is likely the next generation of neuropsychological assessment.

Comprehensive neuropsychological assessment use domain specific tests measuring highly refined cognitive functions. The Frontal Assessment Battery (Oguro et al., 2006), Neuropsychological Assessment Battery (Stern & White, 2003), and Delis-Kaplan Executive Function System (Delis, Kramer, Kaplan, & Holdnack, 2004) are typical of cognitive neuropsychological case reports. Such assessments are widely recognized as important for planning cognitive rehabilitation (see Robinson & Weekes, 2013), because they adopt a bespoke diagnostic system consisting of statistically robust and clinically valid instruments that are tailored to the individual case. On the other hand, use of too many alternative tests makes comparison between different clinical groups difficult, and relies ultimately on choices of a neuropsychologist which can cause subjective biases.

The Oxford Cognitive Screen

The Oxford Cognitive Screen (OCS) (Demeyere et al., 2015) was designed to assess post-stroke cognitive deficits. The key features of the OCS are to minimise demands on language production and visuospatial processing in order to increase test sensitivity to cognitive deficits in five main cognitive domains identified in the cognitive neuropsychological literature: executive control, calculation, number writing, memory, language, and praxis. A distinctive feature of the OCS is all subtasks can be completed with one hand thus reducing the influence of upper limb hemiparesis after stroke. Also, OCS was specifically designed to be inclusive of patients with aphasia and visual neglect. It is constructed from high frequency short words presented orally and visually on a printed booklet, so the patient can reply by pointing instead of producing oral responses. Furthermore, the tasks have been designed to reveal independent cognitive processes in different trials. For example, items in Picture Naming, Picture Pointing and Sentence Reading subtasks are repeated to test language as well the integrity of memory.

Administration of the OCS is relatively fast, i.e. approximately 15 minutes, and testing results are summarized in a visual snapshot, or *Wheel of Cognition*. The UK OCS has been adapted and validated in other languages, such as Cantonese (Kong et al., 2016; 2017; Lam, Kong, Ho, Humphreys, & Weekes, 2014), Italian (Mancuso et al., 2016; 2018), and Putonghua (Hong et al., 2018) suggesting utility for greater post-stroke cognitive screening globally. The development of alternative language versions of the Oxford Cognitive Screen e.g. in Hong Kong (HK-OCS) followed the original OCS validation process closely and resulted in normative scores across three age groups and education levels for Cantonese speakers with very good to excellent values for validity, reliability, and internal consistency. In terms of discriminative validity, Kong and colleagues (2016) reported an excellent value of the HK-OCS to differentiate stroke patients from neurologically intact, healthy adult subjects.

Mancuso and colleagues (2016) reported norms for healthy Italian speakers adjusted for age, education, and gender. Hong et al. (2018) recently published validation study of the Oxford Cognitive Screen with Putonghua speakers in Mainland China (OCS-P) using more advanced statistical methods than previous adaptations. There were psychometric properties reported for younger and older healthy groups and subacute stroke survivors similar to other studies including satisfactory levels of validity, reliability and discriminative properties of the OCS-P (see *Appendix 2* for full comparison of OCS validation procedures with different languages).

Cognitive Screening Assessment in Russia

Development of cognitive screening tools in clinical settings was one of the most important goals of the Soviet school of neuropsychology (Luria, 1966; Luria & Hutton 1977a; Luria & Majovski, 1977b). However, the majority of assessment tools developed in Russian have remained predominantly qualitative and lack rigorous testing of their reliability, sensitivity, and validity (although see Ivanova & Hallowell, 2009, Kuzmina et al, 2017). Akhutina and Melikyan (2012) argued that a scarcity of quantitative neuropsychological assessment tools for Russian speakers was long standing. Luria assumed that *"... higher mental functions may exist only as a result of interaction between highly differentiated brain structures, and that each of these structures makes its own specific contribution to the dynamic whole and plays its own role in the functional system"* (Akhutina, 2015, p.879). According to Luria's syndrome-based approach, each part of a neuropsychological examination should be a separate experiment where a scientist tests theory driven hypotheses about causes of observed cognitive deficits (Luria, 1966). Based on this approach, the Lurian neuropsychological Battery (LNB, Luria, 1966) was developed for testing with a consequent adaptation to the Luria-Nebraska Neuropsychological Battery (LNNB, Golden, 1980). Despite the adaptation and continued widespread use of the LNB in Russia and LNNB in the US, there is a lack of time-efficient screening instruments that are appropriate for clinical practice in Russia (Akhutina & Melikyan, 2012). One consequence of the slow development of standardized neuropsychological tools in Russia is that studies of Russian speakers with neuropsychological impairments have limited impact since there are no valid norms of the established cognitive evaluation procedures. It has been reported that Russian clinicians use cognitive screens that were developed in other linguistic and cultural settings without adaptation, validation and standardization for Russian speakers (Rasskazova, Kovyazina, & Varako, 2016). For example, Russian versions of the MoCA (Makeeva et al., 2012) and MMSE (Levin et al., 2015) are available. However there are no normative or standardized guidelines published for use with the Russian clinical population. This is sub-optimal considering the demands of parameters for evidence based assessment, intervention and research in neuropsychology are growing across the world. Thus, the development of a linguistically and culturally adapted cognitive screen with established psychometric properties for the Russian language would be an advantage for clinicians aiming to deliver standardized neuropsychological diagnostics.

Aims and Hypothesis

Our aim was to develop a reliable, sensitive and valid post-stroke assessment tool for Russian speaking patients by adapting the OCS into Russian (Rus-OCS). To do this, we (1) modified OCS stimuli into culturally and linguistically valid items for Russian speakers; (2) collected reliability, convergent validity, sensitivity and specificity data as well as preliminary normative score values based on 5^{th} and 95^{th} percentiles for this population; and (3) compared performance of neurologically impaired participants with different lesion locations (left versus right) to estimate discriminative power. Selected data is reported here to illustrate the potential of the Rus-OCS for use with typical Russian speakers. Our hypothesis was that Rus-OCS will generate responses that discriminate between Russian speakers with and without cognitive impairment following stroke and more critically provide individual profiles of cognitive impairment with widely acceptable psychometric properties. Based on previous studies (Demeyere et al., 2015; Kong et al., 2016), we also predict that patients who have left hemisphere lesions (LH) will perform worse on subtasks that require language and verbal functions compared with patients who have right hemisphere lesions (RH) who will conversely perform worse than LH patients on subtasks testing visuospatial functions.

Method

Participants

The background demographic and clinical details of 205 participants who had a stroke and 60 healthy participants are summarised in *Table 1*. The stroke participants were recruited from the neurological department of the Treatment and Rehabilitation Center of the Ministry of Healthcare of Russia (Moscow, Russia) according to the following inclusion criteria: (a) premorbid right-handedness; (b) absence of comorbidity with any other health condition of neurological or mental illnesses, severe somatic diseases (e.g., diabetes or intense chronicle pains); (c) absence of severe difficulties in comprehending instructions and/or inability to maintain attention for at least 30 minutes; (d) absence of significant hearing and/or visual deficits; (e) presence of cognitive deficits (based on the neurological admission tests). All patients were assessed by neurologists, optometrists, neuropsychologists and other health specialists upon admission to the Treatment Center. The ability of patients to comprehend instructions was based on comprehensive neurological assessment developed in the Center and administered by specialists and therefore included into all patients' clinical notes.

The sample ranged in age from 18 to 88 years old and comprised 85 women (*Mean* = 63.96, SD = 13.87) and 120 men (*Mean* = 60.32, *SD* = 16.91). Their post-stroke time ranged from 0 to 123 months (*Mean* = 8.44, *SD* = 19.12); there were 32 patients in the acute state (0-

6 days post onset), 116 patients in the subchronic state (1 - 5 months post onset) and 56 patients in the chronic state (6 - 123 months post onset).

Based on information from MRI scans reported in patients' clinical notes, the whole clinical sample was divided into three subgroups with a different location of lesion: left-hemisphere (LH; *n* = 41), right-hemisphere (RH; *n* = 46) and bilateral (BL; *n* = 118) stroke patients. There were no significant differences between subgroups in mean age, years of education and gender balance. The only significant difference was in months post-onset observed between the LH-RH subgroups which was caused by 1-3 outliers who were more than 120 months post stroke in the RH and BL groups (the latter not significant).

As expected, some patients in the clinical subgroups were diagnosed with aphasia. 61% of LH (25 patients: 4 with sensory aphasia, 8 with motor aphasia, 12 with mixed aphasia, 1 with amnestic aphasia), 13% of RH (6 patients: all with motor aphasia), and 9% of BL (11 patients: 3 with motor aphasia, 5 with mixed aphasia, 3 with amnestic aphasia) had language impairments reported in their medical records. Further testing confirmed these observations.

Healthy participants were aged between 20 and 91 years including 40 women (*Mean* = 61.60, *SD* =18.99) and 20 men (*Mean* = 59.85, *SD* = 18.50) all recruited from the Moscow region. Additional analyses of the distribution of education levels across different ages in the healthy group found no significant differences according to socio-demographic data extracted from databases from the official website of the Russian Federal State Statistics Service (http://www.gks.ru/bgd/regl/b12_13/IssWWW.exe/Stg/d2/07-03.htm, accessed 25.06.2018), i.e. the healthy group represented the typical distribution of age-ranges of all Russian citizens.

Exclusion criteria were identical to the patient sample. The visual and hearing acuity of the healthy sample was verified by oral report from participants. There were no significant differences between groups in handedness (all right handed), mean age or level of education. One difference between groups was in their gender composition (see *Table 1*), and this is acknowledged as a limitation of the present study.

All of the participants were informed of the protocol, procedure and outcomes of the research before they signed an informed consent form giving agreement to participate. Participation did not involve any material compensation. However a detailed feedback report on the testing results was provided upon request. All experimental procedures including informed consent for participation in the protocol were approved by the Human Ethics Committee of the University of Hong Kong (HREC's Reference Number: EAl7-07-009). As the participants were recruited from the Moscow Rehabilitation Center, a specific consent for conducting the research and collecting medical records was also obtained through the local ethics committee of the Center.

[Insert Table 1 about here]

Materials

All participants were given the Russian version of MoCA (Makeeva et al., 2012), the LNB (Luria, 1966), and Star Cancellation Test (SCT) (Friedman, 1992) together with the Rus-OCS Version A. Normative data were taken from official websites for MoCA and SCT although we note that neither website provided language or cultural specific norms for the Russian population and all used norms were derived from English speakers with translations. The SCT was adapted for the Russian population by replacing English letters and words with the same length Russian stimuli (*Figure 1*), according to recommendations from the official SCT website which states: ‘the words can be translated into the patients’ native language’ (https://www.strokengine.ca/quick/sct_quick/, version from 3.09.2017).

[Insert Figure 1 about here]

Choice of the validation tasks was inspired by previous studies (Demeyere et al., 2015; Kong et al., 2016). MoCA was used in both abovementioned studies; the gestural production test was used in the HK-OCS validation and is similar with the LNB Dynamic-Kinesthetic Praxis; and SCT used in the UK-OCS. The length of a testing session with Rus-OCS and all validation tasks (including the instructions, explanations and other formal procedures) was approximately one hour on average, allowing a break between sessions. The testing of the clinical sample was complemented with neuropsychological case reports derived from Lurian assessment protocols taken from the medical database of the Center together with patients' MRI scans confirming the stroke location. Relevant data were extracted and used in the psychometric analyses.

42 healthy participants and 15 stroke patients were re-tested with Version B within seven days of testing with Version A (*Mean* = 4.2, *SD* = 1.49). Both versions A and B comprised subtasks measuring identical cognitive domains, with alternative content. For example, four pictures from the Picture Naming task representing hippopotamus, watermelon, flamingo and pear in Version A were replaced by pictures of a spanner, bear, zebra and carrot in Version B.

The retest verification for the majority of the stroke sample was not possible because of the intensive cognitive rehabilitation programme established in the Center which causes a serious bias in the retest values even within 3 days. The 15 patients added into analyses of test-retest reliability were on the waiting list for the beginning of their rehabilitation program which allowed them to be tested before their cognitive training had commenced.

Translation and cultural-linguistic modifications of the OCS to Russian

A majority of cognitive assessment tools is initially developed and validated in Western culture and for English speakers only while being adapted directly and without the cultural considerations necessary for use in other languages. Although, it is impossible to apply norms from any test that is developed in a different culture and language because of obvious linguistic and cultural diversity. A more valid approach is to develop screening instruments that do not depend on knowledge of culture and do not rely on verbal responses in one language only (Kuzmina, et al., 2017). Thus, the cognitive study of neuropsychological impairments in the patients who speak the Russian language requires careful translation and cultural adaptation. There are many linguistic features unique for Russian language in comparison with English (Panchenko et al. 2018.). For example, Russian is written in the Cyrillic alphabet consisting of 33 letters. Russian grammar has a synthetic morphology and syntax with 3 genders and 6 cases. The sentence structure differs from English by use of flexible word order representing semantic meaning (Wierzbicka, 1997). Previous studies on the adaptation of the Birmingham Cognitive Screen to the Russian language (Kuzmina et al., 2017) revealed the importance of following the logic of the initial testing protocol, choosing high-frequency words (except in cases where word frequency is one of the testing parameters) and use of backwards translation i.e. Russian text translated into English by native Russian–English speakers and vice versa as a check of a general translation adequacy.

Two parallel versions of the OCS (A and B) were translated into Russian. Given that English and Russian are both Indo-European languages and the sociocultural background of Russian speakers in Moscow is now very similar to Western culture in many aspects, it was expected that straightforward translation would be suitable for most of the instructions and tasks which can be considered language-neutral (e.g. drawing lines in the Executive task, crossing hearts in the Broken Hearts subtask, or performing calculations on the Calculation subtask). In total, translation of stimuli was necessary in 6 out of 12 subtasks and one subtask of *Picture Naming* requiring the replacement of a single word item. The logic of translation and cultural-linguistic adaptation will be explained below.

Instructions. All subtasks required the translation of instructions. Original instructions from the OCS (English) were composed of simple sentences with high-frequency short words. The same principles were applied to the instructions used in the Rus-OCS which were translated straightforwardly. All instructions were then back translated from Russian into English by three native Russian-English speakers ensuring the resulting back translation was equivalent in meaning to the original OCS text as closely as possible (no errors were noted). The same procedures were applied to the translation of the Rus-OCS parallel Version B.

The *Picture Naming* subtask originally consisted of 4 pictures: *hippo / hippopotamus, melon / watermelon, filing cabinet - chest of drawers, pear*. Due to the absence of a Russian word for “filing cabinet”, the members of the UK OCS team suggested replacement with the item “flamingo”, which was consistently retrieved by a majority of Russian speakers. Replacement of other items in Version A and all items in Version B (*spanner, bear, zebra, carrot*) was not necessary because words had translations in Russian.

The *Picture Pointing* subtask included 4 picture items: *tool, fruit, vegetable, animal* in Version A and *farm animal, wild animal, fruit, tool* in Version B. All pictures categories were familiar for Russian population, so no item replacement was needed.

In the *Orientation* subtask there were 4 questions about time and place where the participant is required to say or point on the booklet in which *city* he or she is right now, what *part of the day* it is now, as well as in which *month* and *year* we are now. In the multiple choice booklet the English city names were replaced with Russian city names that are similar in terms of size and sociopolitical status. Authors of the OCS (Demeyere et al., 2015) recommended using the following logic of cities replacement: 1 - Correct Answer; 2 - Known City of the same size; 3 - Nearest City of the same size; 4 - Known City located nearby.

While the time of the day and the names of months were translated straightforwardly, the items for choice of year were replaced again by the logic provided by Humphreys with colleagues (2012): 1 - [199x where x is the last digit of the current year], 2 - [current year + 1]; 3 - [current year - 1]; 4 - Correct Answer.

In the *Sentence Reading* subtask, sentences including four words (in *italics*) which cannot be read correctly without lexical knowledge were used to detect the signs of surface dyslexia,: 'Интересно, какой *счет* будет в конце игры, - подумал *радостный мужчина*, щурясь от яркого утреннего *солнца*" ('Interestingly, what *score* will be in the end of the game, - the *cheerful man* wondered, squinting because of the bright morning *sun*"). Although Russian is known to be a relatively transparent language for oral reading i.e. that the mappings between orthography and phonology are regular, some words cannot be read correctly via regular grapheme/phoneme mappings (Kornev, Rakhlin, & Grigorenko, 2010; Ulicheva, Coltheart, Saunders, & Perry, 2016). For instance, the letter *т* in the word "*радостный"* (cheerful/[radosnyj]) is omitted during oral reading. In the word "*счет"* (score/[schyot]) the letters *с* and *ч* should be read as one sound [shch] instead of separate sounds corresponding to the letters *с*, [s], and *ч*, [ch]. The reading subtask included such words to screen for surface dyslexia. The use of irregular words allowed for screening of reading ability and potentially pre-morbid level of educational and intellectual function post-stroke. *Table 2* summarises the stimuli that were included in the *Sentence Reading* subtasks of the parallel versions to reveal disturbances to the lexical route and signs of surface dyslexia in Russian.

[Insert Table 2 about here]

The subtasks of *Visual Field*, *Number Writing, Calculation, Broken Hearts, Gesture Imitation, and Executive Functions* subtasks required direct translation of the instructions only because of the non-verbal nature of the testing stimuli. There were no changes in the stimuli in *Episodic recognition* because all pictures were well-known for Russian population and the correct answers were matching with the unchanged pictures of the *Picture Pointing* subtask.

The *Verbal Recall and Recognition* subtask stimuli were replaced on advice of OCS creators: on each trial there was one correct word, one synonym to the correct word, one word which sounds similar to the correct word, and one word with similar meaning with the correct word. The full Rus-OCS version together with directly translated visual snapshot can be found in the *Appendix A.*

Data analysis

The workflow of the present study was very similar to extant validation studies of the OCS (Demeyere et al., 2015; Kong et al., 2016; Hong et al., 2018; see also *Appendix B*). The Kruskal-Wallis test was used to contrast performance of stroke patients with healthy participants on the Rus-OCS subtasks. In addition, we calculated the values of the 5th and 95th percentiles of the performance of healthy participants to estimate preliminary cut-off scores and compare these with reported cut-offs from previous studies (Demeyere et al., 2015). For most of the subtasks, impairment means that the patient's score is lower than the normative value based on the 5th percentiles from the healthy sample. However, in the asymmetry subtask measuring visuospatial neglect, scores higher than the normative score are also evidence of neglect. The same is true for the Executive subtask score which represents the subtraction of scores on the shifting trail task from the sum of two simple trail tasks. Hence, a score that is larger than the normative cutoff on this subtask signifies weaker performance for the shifting condition i.e. the test of cognitive control. To assess possible effects of demographic variables on scores, normative values for three age groups (< 50 years old, 50-69 years old, > 69 years old) and two levels of education (Secondary and Tertiary) were calculated for each subtask. To check the internal consistency of translated subtasks, Cronbach's alpha coefficients (Cronbach, 1951) were calculated. Test-retest reliability was established for the healthy sample and for a separate group of 15 stroke survivors (pre-rehabilitation as discussed above), because other patients were enrolled in cognitive rehabilitation programmes (each patient received at least 3 training sessions per day), which could influence the test-retest results. Convergent validity was investigated via correlations between patient scores for Rus-OCS subtasks and scores for Rus-MoCA subtasks as well as relevant subtasks from the SCT and LNB. To check the sensitivity and specificity of Rus-OCS, MoCA, SCT and LNB were used. Since there are no Russian-specific norms reported for MoCA or SCT, all diagnostic outcomes were additionally supported by results of comprehensive neuropsychological assessments taken from each patient's medical records. In addition, we compared the incidence of impairments in the clinical sample overall (N = 205) and impairments according to different lesion locations. We then compared patients with first stroke in the left hemisphere (n = 41) or right hemisphere (n = 46) to a group with bilateral lesions (n = 118). The Kruskal-Wallis test was used to test for differences between clinical groups in performance on all Rus-OCS subtasks. Additionally, the Chi-square test was used to check for equality in the proportion of impairments on subtasks between clinical groups. Although the OCS is not directly designed for topical neurological diagnostics, the clinical profiles presented here may be helpful for the interpretation of individual results in practice.

Results

Group differences and preliminary cut-offs

Performance on all Rus-OCS subtasks was significantly different between healthy and stroke groups (*Table 3).* Comparison of the preliminary Rus-OCS and UK OCS cut-offs revealed minor differences in the Sentence Reading task (which was completed with 100% accuracy by all healthy participants) whereas a single mistake was considered normal range performance for the UK OCS. At the same time, in the Broken Hearts subtask, the range of normative accuracy (≥40) was slightly lower than in the UK sample (≥42) and the range of scores on the space asymmetry subtask was more balanced (from -3 to 3) than in the UK OCS (from -2 to 3). Another divergent value was detected on the accuracy cutoff score for the Executive Function subtask, which was 2 points higher in the Russian sample (6) than the UK sample (4). All differences will be further discussed in the following Discussion section.

Descriptive statistics for each age cohort are summarised in *Table 4*. Age-related differences for the healthy group were observed for all subtasks except for Picture Pointing and Sentence Reading subtasks which both produced a ceiling effect. In the stroke group, there were no age-related differences on any memory subtask (Verbal Recall and Recognition, Episodic Recognition) or the Executive function subtask scores. In the healthy group, age-balanced groups with lower educational levels had reduced scores on all subtasks except for Picture Pointing, Sentence Reading, Number Writing and Verbal Recall. There were no significant differences between females and males on any subtask for either group (p <.05). In the healthy group, there were significant correlations (p <.001) between age and performance on all subtasks that did not produce ceiling effects i.e., Picture Naming (r_p = -.44), Orientation (r_p = -.37), Broken Hearts (r_p = -.42), Gesture Imitation (r_p = -.64), Verbal Recall (r_p = -.81), Verbal Recognition (r_p = -.64) and Episodic Recognition (r_p = -.60), Executive Score (r_p = .51) and the Mixed Executive task (r_p = -.57). Correlations for the Rus-OCS subtask scores with gender and years of education were not significant (all p's>.05).

[Insert Table 3 and 4 about here]

Internal consistency

Cronbach's alpha was calculated for language scales that contained replacement items only i.e. Sentence Reading, α =.89, Picture Naming, α = .77, Verbal Recall, α = .82, and Verbal Recognition, α = .83. Other scales from the OCS battery (e.g. pictures of hearts in the Broken Hearts subtask, pictures of circles and triangles in the Executive functions subtask, numbers in the Calculation subtask) were not translated and thus satisfactory consistency was assumed.

Reliability

Results of test-retest reliability analyses for healthy and clinical groups are shown in *Table 5a* and *Table 5b* respectively. Retest data were obtained for Version A only due to small sample, so caution is needed when using Version B. There were no significant differences between test and retest scores for any subtask. Correlation coefficients were established at $p < .001$ level for all subtasks for healthy group and at least at $p<0.05$ for stroke patients. Thus, we demonstrated a fair level of test-retest reliability for Rus-OCS Version A.

[Insert Table 5a and Table 5b about here]

Convergent validity, sensitivity and specificity

Table 6 shows results of tests for convergent validity, sensitivity and specificity of Rus-OCS subtasks. The correlation coefficients varied from a moderate level ($r_{p\,=}$ .32 - .49) for Picture Naming and Pointing, Sentence Reading, Number Writing, Calculation, Verbal and Episodic Recognition, and the Mixed Executive Function Task to a high level ($r_{p\,=}$ .50 - 1) for the subtasks of Orientation, Visual Field, Broken Hearts accuracy and asymmetry, Gesture Imitation, Verbal Recall and Executive score. The range of sensitivity of the Rus-OCS varied from .56 to 1 (*Mean* = .79, *SD* = .09). The lowest sensitivity value (.56) was observed for Episodic Recognition. Possible reasons for these results are discussed below. Specificity varied from .73 to 1 (*Mean* = .86, *SD* = .12).

[Insert Table 6 *about here]*

Differences between clinical subgroups

As predicted, we found that Rus-OCS subtasks differentiated clinical groups with differential lesion location: left-hemisphere (LH), right- hemisphere (RH) and bilateral (BL) lesions (see *Table 7)*. Chi-squared values found significant differences on language tasks (i.e. Picture Naming and Pointing, Sentence Reading, Verbal Recall) and visual attention tasks (i.e. Broken Hearts accuracy and asymmetry). LH group had significantly lower scores on Picture Naming (χ^2 = 3.93) in comparison with the BL group. On the Picture Pointing task, LH performed worse than RH group (χ^2 = 5.92). The LH group also had lower scores on the Sentence Reading subtask in comparison with RH (χ^2 = 6.00) and BL (χ^2 = 18.66). On the Verbal Recall subtask, LH was worse than the RH group (χ^2 = 8.54) and the BL group was better than RH (χ^2 = 4.32). In sum, LH patients demonstrated lower performance on all language subtasks. Analysis of the Broken Heart subtask scores measuring visual neglect and selective attention identified that RH patients performed worse than LH in the accuracy subtask (χ^2 = 7.51) and worse than BL on asymmetry measures (χ^2 = 5.34). We analysed impairment ratios based on $5^{th}/95^{th}$ percentiles derived from the healthy sample for each pair of clinical groups with different lesion location. The null hypothesis is that proportions of impaired/unimpaired results should be equal. We can reject this hypothesis as there were significant differences in impairment ratios on tests of language processing (Picture Naming χ^2 = 8.91 and Pointing χ^2 = 7.03, Sentence Reading χ^2 = 5.01, Verbal Recall χ2 = 9.43 and Recognition χ^2 = 3.98) and visuospatial processing (Space Asymmetry χ^2 = 4.89) for the groups with unilateral left or right hemisphere damage. Furthermore, in comparison to the BL group, LH patients had a significantly greater incidence of impairment on verbal tasks (Sentence Reading χ^2 = 16.06, Verbal Recall χ^2 = 4.50), Calculation (χ^2 = 4.72) and Episodic Recognition (χ^2 = 10.05). In comparison to BL group, RH patients had a significantly greater incidence of impairment on Space Asymmetry subtask (χ^2 = 8.44) while being intact on the Picture Pointing subtask (χ^2 = 4.18).

[Insert Table 7 about here]

Discussion

The results confirmed our expectation that the Rus-OCS would discriminate Russian speakers with stroke from healthy people. We also found that patients with left hemisphere lesions (LH) perform worse on subtasks that test language and verbal functions whereas patients with right hemisphere lesions (RH) perform worse on subtasks that tests visuospatial functions. Most critically, Rus-OCS yielded reliable and valid responses and acceptable psychometric properties. We contend that the translation and adaptation of cultural and linguistic properties of the OCS for Russian speakers is reasonable given the similarities with normative scores of the original UK version of OCS and other studies (Kong et al., 2017; Hong et al., 2018).

All subtasks in Rus-OCS retained their purpose despite translation. In the Sentence Reading subtask, a new sentence was created to provide an equivalent level of complexity to the OCS equivalent for Russian speakers. The OCS Sentence Reading subtask is composed of four target words which require lexical knowledge for correct oral reading. The data for the 5^{th} percentiles in the memory subtasks requiring the retrieval of words was equivalent to items in the OCS, so the same level of difficulty can be assumed. The ceiling effect for healthy sample in the Sentence Reading task can be due to more automatized and rapid reading explained by relatively high level of orthographic transparency in Russian (see Ulicheva et al., 2016). A majority of participants in the LH group with aphasia performed significantly worse than the healthy group supporting the conclusion that the Sentence Reading subtask discriminates patients with language deficits.

We noted during testing that most unimpaired participants aged 66 years and older named the picture "flamingo" although two alternative names produced were "heron" and "stork". This is possibly because the post-World War II Soviet generation (after 1950 year of birth) had limited access to higher education, so their lack of general knowledge might be a contributing factor to the present results. In addition, the typical age of retirement in Russia is 55 years for women and 60 years for men (Kolev & Pascal, 2002), potentially restricting familiarity with specific linguistic terms. The use of alternative correct answers in fact corresponds with the original OCS protocol where multiple options are correct for three items of the Picture Naming subtask of the version A. For example, the first 3 pictures from the Picture Naming (Version A could) be named as: (1) hippo / hippopotamus , (2) melon / watermelon; (3) filing cabinet / chest of drawers. Thus, name agreement was considered as a necessary constraint by the OCS developers and they argued that this is as a part of cognitive load of the Picture Naming subtask. Instead of "flamingo", we recommend the item "spanner" (гаечный ключ / gaechnyi klyuch in Russian) from the Version B which was recognized by all participants and consists of two Russian words as the original item "filing cabinet / chest of drawers".

We used Cronbach's alpha coefficients to test the internal reliability of Rus-OCS and values were at least α = .77 which is a high level of internal consistency (Tavakol & Dennick, 2011). The HK-OCS study yeilded only one compound value of internal consistency equals to .725 (Kong et al., 2016). In contrast, for the OCS-P there were relatively low (.30 – .52) alpha coefficients for attention, memory, and language domains (Hong et al., 2018). We therefore submit that Rus-OCS has acceptable reliability comparable to other language versions.

Our goal was to provide normative data to be used as guidelines for clinical use of Rus-OCS. The current dataset yeilds a modest set of normative scores which may be used to estimate cognitive abilities in neuropsychological practice as well as for refinement of cut-offs on larger samples in future. The minimal differences with the OCS cutoffs (Demeyere et al., 2015) observed in the Broken Hearts asymmetry scale and in the accuracy scores on the Executive function task are likely due to sampling differences and are not clinically significant given the range of scores in both tests. Patients with clear problems in these domains would fall under the cut-off point in both cases. Also, the UK healthy group comprised 140 people, whereas only 60 healthy participants represented the Russian sample. Clearly, more healthy participants' data is needed for the Rus-OCS cutoffs interpretation in future studies.

Normative scores were calculated for three different age groups and showed some differences on all subtasks except Picture Pointing and Sentence Reading which demonstrated ceiling effects. Correlation analyses showed stronger effects of age on tests of Memory, Executive Attention and Praxis. The results are consistent with findings in the Cantonese HK-OCS (Kong et al. 2016), although in that study higher scores were observed on Number Writing and Sentence Reading subtasks in a younger group. This difference could be explained by greater cognitive demands imposed when processing Chinese characters as confirmed by neural network modeling (Chang, Plaut, & Perfetti, 2016).

An unexpected finding was that years of education were not significantly correlated with Rus-OCS scores. This contrasts with results from an Italian sample (Mancuso et al., 2016) and studies of MMSE and MOCA. For instance, studies of the MMSE use scoring adjustments for level of education (Crum, Anthony, & Folstein, 1993). Ardila, Ostrosky-Solis, Rosselli, and Gómez (2000) reported that cognitive decline is affected by education level. In the Italian study age and education independently predicted OCS performance. According to the results (Mancuso et al., 2016), level of education had an effect on all cognitive domains but age influenced Orientation only. The authors concluded that demographic factors constrained the use of OCS, and we acknowledge this requirement for future studies on a larger Russian-speaking sample. In our view, the low impact of education on performance reflects the potential of the OCS for use across a broad range of participants. Although the present results confirm the validity of Rus-OCS, it should be noted that all participants were recruited from the Moscow region. Residents of the Moscow (capital) region are more likely to be educated than residents from other parts of Russia due to greater access to media and higher mean income (Vishnevsky & Bobylev, 2009). Therefore, before we can argue that the OCS is education-neutral, data from a wider range of Russian speakers is required. Our expectation however would be that level of education may have an effect on performance for Russian speakers residing outside Moscow. Our results allow the conclusion that age exerts a wider influence on Rus-OCS scores than level of education, although this statement should be verified with a larger stratified sample too.

In the present study, test-retest reliability was established for all subtasks of the Rus-OCS on a healthy sample and a small group of 15 stroke patients. The next step in validation of the Rus-OCS must include assessment of test-retest reliability on a larger group of patients. For valid retest data collection, the choice of general clinic with newly admitted acute stroke patients receiving pharmacological intervention is preferable. We also acknowledge that inter- and intra-rater reliability data must be added to meet criteria for the research use of the Rus-OCS.

We investigated the convergent validity of Rus-OCS based on its correlation with well-known and validated neuropsychological screens. All subtasks showed significant (p<.05) correlations with comparable tasks. Moderate correlations were found on language, numerical, memory and switching subtasks which could be explained by slightly different nature of the comparable validation tasks taken from MoCA scale. For instance, the Rus-OCS Number Writing subtask was correlated with the MoCA Clock Drawing subtask because it includes writing numbers. We argue that the Clock Drawing subtask imposes more demands on the visuospatial system especially regarding the positioning of the clock hands. Although, in terms of the ecological validity of the subtask, the ability to write numbers as measured in the Rus-OCS looks more relevant to life demands for stroke survivors.

The choice of the use of MoCA subtasks for correlation with the Rus-OCS subtasks as a part of the convergent validity analysis was influenced by validation studies of the original OCS and HK-OCS. Similarly, the OCS-P used the Chinese Beijing version MoCA-ChiB as an external measurement of the criterion validity (Hong et al., 2018). However, the short subtasks of the MoCA often have very little range as they are normally interpreted as a part of the MoCA total score. This may lead to relatively small correlations with OCS subtasks. For example, MoCA trail making subtask was correlated with Rus-OCS Executive subtask while having only two values, zero and one. In future studies, the use of fully established and standardized tests for each cognitive domain separately is recommended for a more precise validation procedure.

Estimates of the diagnostic accuracy of Rus-OCS using measures of sensitivity and specificity were based on 5^{th} and 95^{th} performance percentiles derived from the healthy sample and compared with MoCA, SCT and LNB cutoffs taken from their official websites. The true negative rates i.e. the percentage of participants who are correctly identified as not having impairment revealed an acceptable to high level of sensitivity for all subtasks (range .73 – 1) while the probability of impairment detection was again sufficient to high for all subtasks (range .76-1) except for the Episodic Recognition subtask (.56). We suggest that lack of sensitivity may result from greater inclusivity of the Rus-OCS subtask in comparison with matching tasks for validation. For example, the Episodic Recognition subtask has a visual multiple-choice response mode which allows patients who have language difficulties or endotracheal tube to respond by pointing not speaking. Comparable scores on the test of

Episodic Memory on the MoCA may be confounded, as a failure on this task may be due to inability to respond verbally. This argument is confirmed by the fact that, according to medical records, at least 20% (n = 42) of the stroke sample were diagnosed with aphasia.

Our preliminary results confirmed that Rus-OCS can differentiate performance of cognitively impaired and unimpaired Russian speakers. Moreover, the Rus-OCS is sensitive to lesion lateralisation in the case of left hemisphere brain damage with language subtasks (Picture Naming and Pointing, Sentence Reading, Verbal Recall) and right hemisphere brain damage on tests of visual attention (Broken Hearts accuracy and asymmetry). Our findings therefore confirm that the stroke patients with left hemisphere damage are likely to have impairment to language functions (object naming, oral reading, semantic processing, verbal recall). In contrast, stroke patients with right-hemisphere damage perform significantly worse on visuospatial attention tasks. Analysis of the impairment ratios within each group confirmed these results. We also compared results of the lesion groups with BL patients without clear lateralisation of brain damage. The BL would be expected to show functional impairments typical of brain damage for either hemisphere but not show isolated impairment to language or visuospatial processing. The BL group thus serves as a control group for comparisons of specificity with LH and RH groups because all participants have brain damage that causes cognitive impairment. The comparisons between LH and BL groups and between RH and BL groups therefore allow conclusions about the specific impairments caused by damage to one hemisphere independent of the effects of brain damage per se. According to this reasoning, damage to the left hemisphere in the present sample leads to impairment in verbal functions whereas damage to the right hemisphere leads to impairment in visuospatial functions. These findings are compatible with what is known about the lateralisation of cognitive functions in the brain. Moreover, in the HK-OCS validation study similar results were presented after paired-sample *t*-test between scores of left and right hemispheric stroke groups. According to Kong and colleagues (2016), significant differences between LH and RH groups were observed in the Sentence Reading, Orientation (free response), Verbal Memory (recall), Number Writing, and Calculation subtasks for Cantonese speaking participants.

We seek to confirm the discriminative power of Rus-OCS for different lesion localisations in future studies. In the present study, the BL group had the largest number of participants and can be characterised as chronic (recurring strokes were noted in the records). This group had more diverse pathology with multifocal strokes but had been admitted to hospital with acute lesions during the data collection period. Not surprisingly, this group was characterised by diverse and widespread cognitive impairment in comparison to unilateral stroke patients and by some measures may be seen to have greater functional impairment due to extensive brain damage. We noted however, that BL stroke patients had better language performance than the LH as well as better visuospatial functioning in comparison with RH group. Based on the percentage of impairments for the BL group, we can conclude that memory (verbal and nonverbal), visual attention and numerical function are vulnerable in Russian speaking stroke patients with bilateral lesions. For the LH group, we found that calculation and episodic memory impairments are more likely when compared to patients with BL damage in addition to expected impairments to oral reading and verbal memory recall functions. For the RH group, we found that space asymmetry is more likely to be impaired when compared to patients with BL damage.

The lesion results described above are impressionistic but consistent with results of previous studies (Kong et al., 2016; Kleinman et al., 2007; Xing et al., 2015). MRI studies show that language processing is left lateralized (Frost et al., 1999). Human neuropsychological research shows that LH patients have more impairments with calculation in comparison with RH patients (Rosselli & Ardila, 1989). A higher percentage of failures on the episodic memory task in the LH group might be caused by the disturbed encoding processes associated with activity of left prefrontal cortex (Fletcher, Frith, & Rugg, 1997). We would caution against direct comparisons between the LH and RH groups because cohort studies suggest that patients with RH lesions have fewer functional impairments initially and have a better cognitive recovery (Hochstenbach, den Otter, & Mulder, 2003; Patel, Coshall, Rudd, & Wolfe, 2003). One reason for this may be preservation of language abilities following damage to the right hemisphere. We contend that isolated damage to the right hemisphere results in fewer impairments compared with damage to the left hemisphere. It is not clear however if this is because of preserved language abilities only following brain damage. The RH group had no impairment to language, but Rus-OCS is designed to be insensitive to language impairment. Thus, we expected performance to dissociate impairments to cognitive processes that do not depend on language or visuospatial processing ability. We therefore conclude that the differential impairments observed for patients with left and right lateralised brain damage are resilient to adaptations that diminish language and visuospatial processing abilities.

The results with lateralized deficits might help specialists with the selection of lesion-laterality specific treatment methods. However, more detailed investigation of patients with the bilateral stroke is required due to the increasing incidence of chronic stroke in Russia (Gusev, Skvortsova, & Stakhovskaia, 2002; Mukher & Patil, 2011). Presentation of bilateral stroke in the Russian healthcare system is often accompanied by diagnosis of discirculatory encephalopathy (Levin, 2012). This is a term used in Eastern Europe to describe the chronic progressive form of cerebrovascular pathology leading to multifocal or diffuse brain lesions and causing a variety of neurological and neuropsychological disorders (Yakhno, Levin, & Damulin 2001). The definition is similar to the concept of small vessel disease (SVD) in Western countries (Pantoni, Poggesi, & Inzitari, 2010; Pantoni, 2011). It is notable that the literature on the clinical features of SVD has not made an impact in Russia to date. As the Rus-OCS has good sensitivity, we suggest it could be used at the earliest stage of progressive vascular disease.

Limitations

The limitations of this study lie in the normative sample size and type and gender imbalance, thus preventing generalisation of the results to the Russian population.

Another serious flaw of the present work is lack of test-retest, inter- and intra-rater reliability coefficients. Test-retest reliability should be established using a larger clinical sample and using Version B of the Rus-OCS as well, as it is important for clinicians to know whether the same patient will score similarly on the same test when no changes in underlying impairments can be expected. Since test-retest reliability could not be ascertained with the most of the clinical sample, this issue must to be addressed in future studies together with all other reliability parameters.

One more limitation is the lack of sensitivity of the Episodic Recognition caused by differentiating level of difficulty in the validation task. We note that language and visual impairments add noise to the data. In future studies, use of established and standardized tests for all cognitive domains separately is recommended for further exploration of the Rus-OCS convergent validity.

Another part of construct validity, divergent validity, wasn’t reported in the present work. Based on results of the original OCS validation study (Demeyere, et. al., 2015), we would expect low correlation values of all OCS subtasks with Barthel index measuring physical activities of daily life and quality of life. Additionally, low correlation values were reported between Memory and Attention/Executive domains as well as between Executive and Praxis subtasks of the UK OCS.

Conclusions

In sum, the Rus-OCS has a fair level of validity based on this preliminary study allowing us to recommend it for further validation and use in clinical practice with Russian speakers. During development, we received positive comments from members of the multidisciplinary clinical team in Moscow. The depiction of patient profiles was found to be very convenient for family members and caregivers, providing them with additional cues about the cognitive strengths and weaknesses of a patient. Due to its speed and easy administration, comprehensive assessment and language neutrality, the Rus-OCS is suitable for inclusion into clinical practice and routine assessments immediately with further development to follow.

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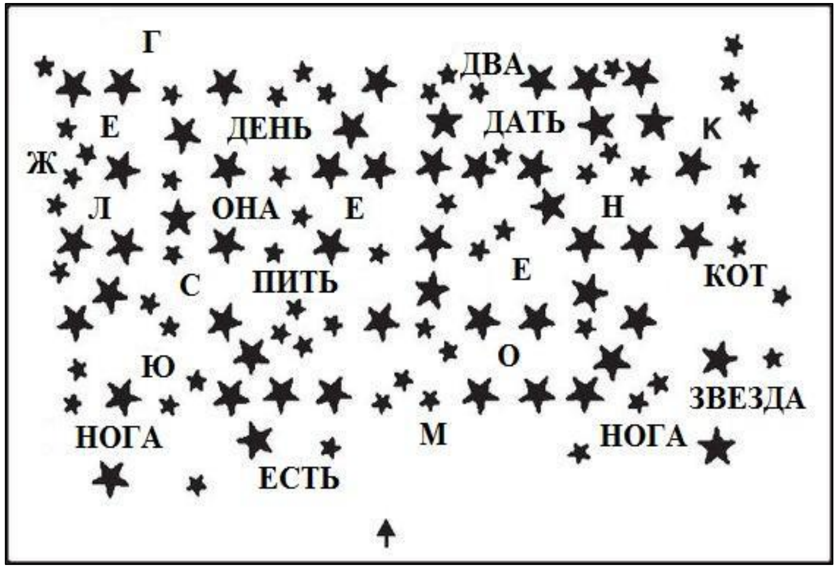

Figure 1.
Russian version of the Star Cancellation Test

Table 1.

Demographic and clinical details of all participants

Characteristics	Healthy participants *N* = 60			Patients with stroke *N* = 205			χ2 or t-values	LH Patients *n* = 41			RH patients *n* = 46			BL patients *n* = 118			χ2 or t-values		
	M	*SD*	*Range*	*M*	*SD*	*Range*	*Healthy vs Stroke*	*M*	*SD*	*Range*	*M*	*SD*	*Range*	*M*	*SD*	*Range*	*LH-RH*	*LH-BL*	*RH-BL*
Age in years	61	19.03	20-91	62	15.78	18-88	1.15	58	14	18-79	66	12.32	32-80	61	17.47	18-88	-2.59	-0.9	1.67
Education in years	15	2.7	7-21	15	1.5	9-20	2.78	15	1.8	9-20	16	1.44	9-20	15.6	1.40	9-18	1.33	1.23	0.55
Female % (*n*)	66% (*40*)			41% (*85*)			5.98*	41% (17)			41% (19)			41% (49)			0.01	0.02	0.18
Months post onset	NA			8.44	19.12	0-123		3	4.68	0-21	11	21	0-122	9	20.64	0-123	-2.02*	-1.62	0.48

Note. **p* < .05

Table 2.

Irregular words used in the Rus-OCS Sentence Reading subtest

Word	Spelling [Pronunciation]	Irregularity
1A. счёт, *score*	***sch***ot [***shch***ĭot]	two letters ***s*** and ***ch*** are pronounced as one sound [sch] instead of [s] and [ch]
2A. радостный, *cheerful*	rados**t**nyi [radosnȳĭ]	***t*** is not pronounced
3A. мужчина, *man*	mu***zhch****ina* [mu***shch***ina]	two letters ***zh*** and ***ch*** are pronounced as one sound [shch] instead of [zh] and [ch]
4A. солнца, *sun*	so***l***ntsa [sontsa]	***l*** is not pronounced
1B. что, what	**ch**to [shto]	***sh*** is pronounced instead of **ch**
2B. нового, new	novo**go** [novo**va**]	***go*** is pronounced as ***va***
3B. мужчина, *man*	mu***zhch****ina* [mu***shch***ina]	two letters ***zh*** and ***ch*** are pronounced as one sound [shch] instead of [zh] and [ch]
4B. мягкое, soft	mya**g**koye [mya**kh**koĭe]	the voiced consonant sound ***g*** is substituted by its voiceless pair sound [***kh***]

Table 3.
Performance of patients with stroke and healthy participants in the Rus-OCS tasks

Rus-OCS task, measure	Score range	Healthy participants (N = 60)				Patients with stroke (N = 205)				Kruskal-Wallis χ^2			
		Mean	*SD*	*Range*	*5th and 95th PCTL*	*Mean*	*SD*	*Range*	*%*	*Stroke vs Healthy*	*LH vs Healthy*	*RH vs Healthy*	*BL vs Healthy*
Picture Naming, accuracy	0-4	3,77	0,56	2-4	3	3,11	1,27	0-4	22	16.51**	18.35**	9.56**	12.24**
Picture Pointing, accuracy	0-3	3	0	3-3	3	2.87	0.49	0-3	12	10.02**	10.81**	0.81	11.31**
Orientation, accuracy	0-4	3.92	0.33	2-4	4	3.49	0.91	0-4	32	14.35**	16.12**	12.18**	10.42**
Visual Field, accuracy	0-4	3.95	0.29	3-4	4	3.7	0.76	0-4	20	6.99**	2.07	8.74**	6.62*
Sentence Reading, accuracy	0-15	15	0	15-15	15	12.27	5.1	0-15	36	27.75**	46.99**	25.91**	17.67**
Number Writing, accuracy	0-3	2.98	0.24	2-3	3	2.41	1.02	0-3	52	19.39**	16.29**	4.29*	19.75**
Calculation, accuracy	0-4	3.65	0.55	2-4	3	3.2	1.05	0-4	45	8.69**	5.83*	0.51	8.01**
Broken Hearts, accuracy	0-50	44.56	8.18	32-50	40	35.2	13.68	0-50	52	35.29**	4.61*	29.83**	32.97**
Broken Hearts, space asymmetry	-25 – 25	0.18	1.26	-4 – 5	-3– 3	3.37	5.16	-18 – 25	32	12.48**	4.38*	13.90**	4.60*
Gesture Imitation,	0-12	10.72	1.89	4-12	8	8.66	3.55	0-12	32	18.13**	15.54**	7.22**	14.90**

accuracy													
Verbal Recall , accuracy	0-4	2.24	1.53	0-4	0	0.95	1.33	0-4	81	35.93**	21.20**	6.16*	29.27**
Verbal Recognition, accuracy	0-4	3.28	1.16	0-4	3	2.21	1.43	0-4	68	30.11**	13.84**	11.41**	26.09**
Episodic Recognition, accuracy	0-4	3.72	0.6	1-4	3	3.25	1.05	0-4	45	11.92**	11.48**	1.49	9.07**
Mixed Executive task, accuracy	0-13	11.31	3.14	1-13	4	8.45	4.62	0-13	52	24.82**	10.74**	20.84**	14.86**
Executive score, accuracy	-13 – 12	0.20	2.61	-3-10	-2 – 6	1.88	3.64	-10 - 12	16	18.02**	11.40**	10.63**	12.23**

Note. ***p* < .001; *PCTL* = percentile, % = percentage of impairments

Table 4

Variation of the Rus-OCS scores by age and education

Rus-OCS task, measure	Healthy participants					Patients with stroke				
	Age			Education		Age			Education	
	<50	50-69	>69	Secondary	Tertiary	<50	50-69	>69	Secondary	Tertiary
	n=22	*n*=18	*n*=20	*n*=20	*n*=40	*n*=45	*n*=85	*n*=75	*n* = 64	*n*=141
Picture Naming, accuracy	3	4	2	2	3	0	0	1	0	0
Picture Pointing, accuracy	3	3	3	3	3	2	0	2	1	2
Orientation, accuracy	4	4	2	2	3	2	0	1	1	1
Visual Field, accuracy	4	4	2	4	3	2	2	2	3	2
Sentence Reading, accuracy	15	15	15	15	15	0	0	2	4	4
Number Writing, accuracy	3	3	2	3	3	0	0	1	0	0
Calculation, accuracy	3	3	2	2	3	2	1	1	1	1
Broken Hearts, accuracy	38	42	0	38	44	13	0	0	0	3
Broken Hearts, space asymmetry	-4	-3	-4	-4	-3	-7	-9	-10	-7	-9
Gesture Imitation, accuracy	11	9	4	4	7	2	0	1	1	1
Verbal Recall , accuracy	1	0	0	0	0	0	0	0	0	0
Verbal Recognition, accuracy	3	3	0	0	1	0	0	0	0	0
Episodic Recognition, accuracy	4	4	1	2	3	1	1	1	1	1

Mixed Executive task, accuracy	7	11	1	3	6	0	0	0	0	1
Executive score, accuracy	-1	-2	-3	-3	-3	-2	-2	-2	-1	-1

Table 5a

Descriptive statistics and comparison of test and retest performance (after 3– 7 days) for 42 healthy participants

Rus-OCS task, measure	First test		Second test		Wilcoxon signed rank test	Exact score of agreement, %	r_p
	Mean	*SD*	*Mean*	*SD*	*p*		
Picture Naming, accuracy	3.83	0.49	3.90	0.29	0.18	95	.73**
*Picture Pointing, accuracy	3	0	3	0	1	100	X
Orientation, accuracy	3.98	0.15	3.98	0.16	1	100	1**
Visual Field, accuracy	3.95	0.30	3.95	0.31	1	100	1**
Sentence Reading, accuracy	15	0	15	0	1	100	X
Number Writing, accuracy	2.98	0.154	3	0	0.32	98	X
Calculation, accuracy	3.69	0.46	3.81	0.40	0.59	83	.59**
Broken Hearts, accuracy	45.19	7.734	45.36	7.57	0.22	79	.80**
Broken Hearts, space asymmetry	-0.11	1.02	-0.10	1.05	0.82	90	.73**
Gesture Imitation, accuracy	11	1.41	11.05	1.45	0.53	83	.94**
Verbal Recall , accuracy	2.57	1.346	2.74	1.11	0.12	71	.86**
Verbal Recognition, accuracy	3.64	0.821	3.74	0.70	0.16	88	.85**
Episodic Recognition, accuracy	3.86	0.354	3.90	0.30	0.32	90	.56**
Mixed Executive task, accuracy	12.07	2.37	12.12	2.37	1	88	.97**

Executive score, accuracy	-0.21	2.18	-0.18	2.23	0.58	100	1**

Note. ***p* < .001; X = Pearson correlation was unable to be computed because at least one group's scores are constant.

Table 5b

Descriptive statistics and comparison of test and retest performance (after 3– 7 days) for 15 stroke patients

Rus-OCS task, measure	First test		Second test		Wilcoxon signed rank test	Exact score of agreement, %	r_p
	Mean	*SD*	*Mean*	*SD*	*p*		
Picture Naming, accuracy	3.22	0.81	3.66	0.68	0.33	40	0.60*
Picture Pointing, accuracy	2.83	0.38	2.66	0.69	1	72	1**
Orientation, accuracy	3.71	0.47	3.33	1.71	1	61	0.49*
Visual Field, accuracy	3.78	0.65	3.71	0.83	0.95	100	1**
Sentence Reading, accuracy	11.11	5.35	11.39	3.60	0.56	40	0.59**
Number Writing, accuracy	2.61	0.85	2.61	0.78	1	93	0.74**
Calculation, accuracy	3.0	1.28	3.17	1.30	0.83	83	0.96**
Broken Hearts, accuracy	29.83	12.93	30.04	13.12	0.22	41	0.54*
Broken Hearts, space asymmetry	-2.72	3.61	-3.01	4.54	0.28	44	0.48*
Gesture Imitation, accuracy	8.38	3.05	8.11	3.79	0.40	56	0.83**
Verbal Recall , accuracy	0.61	0.92	0.70	1.07	0.15	44	0.49*
Verbal Recognition, accuracy	1.89	1.28	1.92	1.34	0.89	72	0.66**
Episodic Recognition, accuracy	2.56	0.98	2.50	1.25	0.59	67	0.58*

Mixed Executive task, accuracy	6.72	4.60	7.03	3.67	0.81	83	0.73*
Executive score, accuracy	1.28	1.96	1.27	1.46	1	100	1**

Note. *$p<0.05$; **$p < .001$; X = Pearson correlation was unable to be computed because at least one group’s scores are constant.

Table 6

Convergent validity, sensitivity and specificity of the Rus-OCS tasks on patients with stroke

Rus-OCS task, measure	External task	*n*	r_p	*Sensitivity*	*Specificity*
Picture Naming, accuracy	MOCA Naming	127	.35**	.78	.90
Picture Pointing, accuracy	MoCA Naming	127	.33**	.78	.96
Orientation, accuracy	MOCA Orientation	127	.70**	.87	.87
Visual Field, accuracy	SCT_assymmetry	50	.95**	.77	.83
Sentence Reading, accuracy	MoCA Sentence repetition	127	.33**	.81	.96
Number Writing, accuracy	MoCA Clock Total	127	.37**	.76	.74
Calculation, accuracy	MOCA - Serial Subtraction	127	.47**	.83	.72
Broken Hearts, accuracy	SCT total	50	.70**	1	.73
Broken Hearts, asymmetry	SCT asymmetry	50	.93**	.77	.77
Gesture Imitation, accuracy	Dynamic Kinesthetic Praxis	127	.65**	.85	.94
Verbal recall , accuracy	MOCA Delayed Recall	127	.53**	.89	.73
Verbal recognition, accuracy	MOCA Delayed Recall	127	.45**	.80	.90
Episodic recognition, accuracy	MOCA Delayed Recall	127	.43**	.56	1
Mixed Executive task, accuracy	MOCA Trails	127	.32**	.77	.75

Executive score, accuracy	MOCA Trails	127	.54**	.87	.91

Note. $^{**}p < .001$.