PsyCh Journal
INSTITUTE OF PSYCHOLOGY
Chinese Academy of Sciences

PsyCh Journal **5** (2016): 18–30
DOI: 10.1002/pchj.130

Variability of writing disorders in Wernicke's aphasia underperforming different writing tasks: A single-case study

Elena Kozintseva[1,2] and Anatoliy Skvortsov[1,3]

[1]Department of Medical Psychology, Center for Speech Pathology and Neurorehabilitation, Moscow, Russia, [2]Psychological-Social Faculty, Pirogov Russian National Research Medical University, Moscow, Russia, [3]Department of Psychology, Faculty of Social Sciences, National Research University Higher School of Economics, Moscow, Russia

Abstract: The aim of our study was to evolve views on writing disorders in Wernicke's agraphia by comparing group data and analysis of a single patient. We showed how a single-case study can be useful in obtaining essential results that can be hidden by averaging group data. Analysis of a single patient proved to be important for resolving contradictions of the "holistic" and "elementaristic" paradigms of psychology and for the development of theoretical knowledge with the example of a writing disorder. The implementation of a holistic approach was undertaken by presenting the tasks differing in functions in which writing had been performed since its appearance in human culture (communicative, mnestic, and regulatory). In spite of the identical composition of involved psychological components, these differences were identified when certain types of errors were analyzed in the single subject. The results are discussed in terms of used writing strategy, resulting in a way of operation of involved components that lead to qualitative and quantitative changes of writing errors within the syndrome of Wernicke's agraphia.

Keywords: agraphia; cultural functions of writing; holistic approach in psychology; single-case study; task effect
Correspondence: Dr. Anatoliy Skvortsov, Faculty of Social Sciences/School of Psychology, Higher School of Economics, 46b Volgogradsky Prospekt., Moscow 109316, Russia. Email: skwortsow@mail.ru
Received 22 November 2015. Accepted 15 February 2016.

In this article we discuss differences between group and individual case studies for the analysis of theoretical positions. Ideas about the importance of individual cases for revealing psychological laws were clearly articulated in the writings of German psychologist Kurt Lewin (2001), who showed difference between "Aristotelian" and "Galilean" ways of scientific thinking.

Lewin, who tried to follow the Galilean tradition, supposed that the task of psychological science is establishing a law that would explain all phenomena without exception, including those that are "accidentally" in line with Aristotelian logic. In other words, a Galilean study should identify general laws as well as specific conditions under which one phenomenon develops from another. A single case can be a useful tool in Galilean-type research for revealing the universal law, since a case can demonstrate the law in its pure form. According to the Aristotelian way of thinking, however, it is possible to detect statistical regularities of events rather than a universal law. In clinical research, there is a great variety of manifestations of psychological disorders. Thus, it is very important to identify selection criteria for a single-case study of a Galilean kind, that is, a study that can reveal a universal law in its pure form in a unique patient.

Our study is an example of a situation in which analysis of a single case reveals contradictions presented in latent form in the averaging of group data. Illustration of resolving these contradictions will be carried out by comparing elementaristic and holistic approaches to manifestations of Wernike's agraphia in different writing tasks.

However, this comparison will not be arranged as an opposition. One of the main features of Galilean-type thinking is its so-called Socratic function. This means that

the aim of scientific discussion should not be confirming one position or falsifying the other. Socratic dialogue implies identifying the positive core of the confronting point of view and using its internal contradictions for developing it to a point where the criticized theory can be considered as a correct but local statement in the context of a more general theoretical system (Akhutin, 1976; Skvortsov & Romaschuk, 2015). The upcoming discussion is an attempt at a Socratic dialogue between elementaristic and holistic approaches to agraphia.

Elementaristic and holistic tradition in neuropsychology

The systematic study of aphasia and related disorders started approximately 150 years ago. Of the numerous studies in this field, the first branch of research was related to clarification of the components of the language function. The main aim of these studies was to define the components of language that are impaired after local brain damage that leads to a distinctive form of aphasia (Finger, 1994; Goodglass, 1993; Kussmaul, 1879; Lichtheim, 1885).

Speech was considered as a system consisting of components that are separate, independent and constant in their properties and are involved in the implementation of different speech tasks. In addition, the study of the psychological components that support the use of language was closely connected to the classification of the typical speech tasks. For example, in the Wernicke–Lichtheim concept, in Luria's theory of systemic dynamic localization of higher mental functions and advanced cognitive model (Beauvois & Dérouesné, 1981; Bub & Kertesz, 1982; Caramazza, 1988; Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001; Coltheart & Caramazza, 2006; Ellis, 1982; Houghton & Zorzi, 2003; Lichtheim, 1885; Luria, 1950, 1973, 2002; Luzzatti, 2008; Morton, 1969, 1980; Rapcsak, Henry, Teague, Carnahan, & Beeson, 2007; Rapcsak et al., 2009; Roeltgen, 2003; Shallice, 1981; Tainturier & Rapp, 2001; Tsvetkova, 2002), the fact that certain components of speech are dynamically rearranged when performing different tasks, such as repetition, nomination, and so forth, is substantial. Thus, pointing to the great complexity of the structure of writing as a mental function, Luria notes that its component structure is studied in detail in psychology and includes a number of universal components that are non-specific in relation with the writing task: Psychology is well aware that the process of writing, whether it is writing to dictation, written narration, or even copying, is not a simple psychological act. No matter the difference of psychological mechanisms of writing in each of the mentioned cases, each process of writing includes many common components (Luria, 2002, p. 17).

The described approach can be classified as elementaristic and has been criticized by the followers of Gestalt psychology (Keller, 1998; Koffka, 1998; Lewin, 2001; Wertheimer, 1980), though Gestalt psychology has not denied the very existence of psychological components. As mentioned earlier, Galilean discussion is not about verification or falsification of the theories, but about mutual development through the inclusion of one theory in the context of the other. From this viewpoint, the statement of Gestalt psychologists was that components of psychological functions exist but they are secondary in relation to the holistic activity in which they are included. For example, when looking at Rubin's vase, different elements of the image will be identified depending on whether they constitute the vase or human faces. Thus, the whole generates its own specific elements and gives them new properties that are necessary for the existence of the whole ("whole" in terms of Gestalt is a holistic perceptual image, in our case it means a holistic activity involving writing and actualized by its function). Therefore, studying components that are excluded from the whole in which they exist is not justified. In neuropsychology, this tradition was shared by researchers like Flurans, Jackson, Head, Goldstein and others (Goldstein & Scheerer, 1941; Goldstein, 1942, 1948; Head, 1963; Jackson, 1878; Lashley, 1929; Taylor, 1932; Vizel, 2002; Vinarskaya, 2007).

Based on achievements in physiology, there was an attempt to integrate the principle of the task dependence of a psychological act with the holistic principle (Anokhin, 1955, 1971, 1975; Bernstein, 1991, 2008; Lashley, 1929). In particular, Anokhin's theory of functional systems (Anokhin, 1935, 1975) and Bernstein's physiology of activity (Bernstein, 1991) laid the foundation for the consideration of a subject's activity aimed at achieving the adaptive result as a key factor of physiological functional systems. The mechanism of the acceptor of an action's result in the functional system, as well as the active character of the interaction between the organism and the environment (Bernstein, 1991), allows for the consideration of the participant's activity that is aimed at realizing different tasks as a determinant of the dynamic structure of physiological functional systems. It was demonstrated that performing different physiological tasks could not be explained by the

elementaristic approach, which states that a new task actualizes a new composition of the same components. According to the holistic principle, the task generates the particular components and stimulates specific changes of their properties. Experiments by Anokhin proved that changes in properties of the components of the holistic adaptive physiological act depended on the performed task (Anokhin, 1935, 1955, 1971). Anokhin argued that when an animal performs the same physiological task under certain pathological conditions, its anatomical organs can be used for previously untrained acts or even for functions for which they were not specified. A dog's breathing nerves (going into the intercostal muscles) were cross-linked with its leg muscle nerves, and at first, moving a paw caused the dog's breath to go astray. However, after a while the dog learned to breathe and move its paw, which it controlled from its respiratory center. Further, in the case of one kidney's dysfunction, the other kidney's function intensifies and the release of water through a gastrointestinal tract increases. Thus, each component of the physiological act changes its properties, based on the logic of the problems that need to be solved by the organism as a whole.

However, direct transfer of these ideas from physiology to neuropsychology is hardly possible. We need to reconsider the holistic principle and the principle of task-determined activity in psychological terms.

For this matter, the positions formulated in the framework of the cultural-historical tradition and the psychology of activity (Leontiev, 1981, 1994, 2004; Vygotsky, 1983) are of great importance, since the idea of the cultural and historical nature of the human mind was developed in these works. Following this logic, it can be assumed that the study of mental processes in a healthy person and following a disease should be carried out in the context of solving tasks that have cultural-historical origins.

Consequently, psychological tasks should be studied in the context of holistic meaningful forms of human activity, that is, in the context of cultural-historical functions.

The foregoing position may be used in particular for the study of agraphia. Disturbances of writing were chosen as an object of study as writing is an example of a cultural psychological process. To understand what cultural-historical functions of writing may be actualized in the experiment, it is necessary to consider the conditions of their appearance in anthropogenesis.

Analysis of the history of writing (Assmann, 2004; Brudnyi, 1972; Istrin, 1965; Kliks, 1983; Leontiev, 1981; Liaudis & Negure, 1983; Likhachev, 1951; Mazunova, 2006; Zinkovskaya, 2005) makes it possible to identify the main cultural-historical functions that gave rise to this process. There are seven known functions of writing, such as communicative, reflective, signal, and so forth. Three of these—communicative, regulatory, and mnestic—were chosen for the experiment. The communicative function is transmitted information to addressees separated by distance or time. In the history of writing, the communicative function is found in the ancient tribes—there were signs, patterns of stones, sticks stuck in the ground to inform tribesmen about the direction of the movement of the tribe, or possible dangers (Kliks, 1983; Jean, 2005; Mazunova, 2006). In our study, the communicative function of writing was implemented through informing the social service by the patient. The regulatory function of writing is planning and controlling activities of the participant via external means (schedules, planners, to-do lists, etc.). The regulatory function appeared during magical rites, where signs replaced the forces that were supposed to promote or inhibit something meaningful in life (Doblhofer & Friedrich, 2002; Istrin, 1965; Kliks, 1983; Likhachev, 1951; Zinkovskaya, 2005). In our study, this function of writing has been realized through the patient's creation of a written plan of her future actions before the execution of numerous tasks. The mnestic function appears in the form of personal records, accounting books when netting loans and debentures (Doblhofer & Friedrich, 2002; Jean, 2005; Kliks, 1983). The main condition for the actualization of this function is the need to store information of great volume or for a long period of time. In our study, the mnestic function was recreated by the task of memorizing a picture with a large number of details for identifying it among distractors after a week's period.

Our assumption was that the manifestations of writing disorders in Wernicke's agraphia syndrome change when implementing different kinds of tasks corresponding to different cultural-historical functions of writing.

Materials and methods

Participants

Description of the group of participants

The study involved 29 participants aged from 34 to 67 years (mean age, 53 years ± 9.28), including 17 males and 12 females. Eighteen patients had higher education, nine had secondary vocational education, and one patient had secondary education.

The participants' occupations were not related to the active use of written language—there were no linguists, philologists, or writers of any kind among the patients. All participants were native Russian speakers and were right-handed. Neurological observation of all participants revealed a stroke in the basin of the left middle cerebral artery.

The group of patients was selected to minimize the possibility of associated disorders, including several types of aphasia or other disorders of mental functions (gnosis, praxis) that provoke secondary writing disorders. Selection criteria in the experimental group were: (a) sensory (Wernicke's) aphasia in neuropsychological status; (b) severity of speech disorders, from mild to moderate; and (c) sensory agraphia according to neuropsychological testing.

All of the patients were examined by methods based on Luria's neuropsychological examination (Luria, 1947, 1973, 2008). Comprehensive neuropsychological examination included subtests to study praxis, gnosis, memory, attention, and speech, including reading, writing, and counting. Also, the general characteristics of patients were assessed (orientation in time and space, individual critique to one's condition, emotional state, neurodynamic parameters, and executive functions). Quantitative Assessment of Speech Symptoms in Aphasia included subtests on impressive (estimated speech understanding in the dialogue, showing objects and actions, following instructions, understanding phrases) and expressive (evaluation dialogic speech, naming verbs and nouns and story-telling based on picture stimuli) speech (Tsvetkova, Akhutina, & Pylaeva, 1981). Patients were excluded from the group by the following criteria: (a) age younger than 30 or older than 70 years; (b) education below secondary level; (c) pathology of the brain areas differing from temporal region of speech-dominant hemisphere according to magnetic resonance imaging; (d) hearing loss diagnosed by otolaryngologist; (e) symbolic agnosia; and (f) disorders of executive functions, as well as diffuse atrophic changes.

According to the results of neuropsychological examination by a clinical psychologist using Luria's method, sensory aphasia (Luria's term, which corresponds with Wernicke's aphasia in Western neuropsychology) was identified in all cases. According to the Quantitative Assessment of Speech Symptoms in Aphasia by Tsvetkova et al. (1981), the severity of speech disorders differed from medium-light to medium. The degree of impressive speech disturbance and the capacity of verbal memory test were sufficient for a proper understanding of instructions for the experimental tasks.

The study was conducted in the Center for Speech Pathology and Neurorehabilitation, Moscow, Russia.

Description of the single patient

The patient who will be described separately is a participant of the same group. Patient P. was a 66-year-old woman, admitted to the Center for Speech Pathology and Neurorehabilitation at during September, 2010.

The patient had higher education, a PhD in history; she worked as a head of a sector in a library. The results of tomography and functional diagnostic methods are as follows. Magnetic resonance imaging of the brain, February, 2009: A picture of single vascular lesions in the white matter of the brain, which had vascular genesis. Brain computed tomography, September, 2009: A picture of a few vascular lesions in the white matter of vascular origin, moderate expansion of external and symmetric, inner liquor spaces. Electroencephalogram, September, 2010: Moderate changes of electrical activity of general cerebral type. Functional electrical activity changes of mesodiencephalic origin. Paroxysmal activity has not been identified. Slow-wave activity in the left hemisphere dominates in the frontal-temporal region.

During the comprehensive neuropsychological examination with the method of Luria and the method of Quantitative Assessment of Speech Symptoms in Aphasia by Tsvetkova et al. (1981), the speech therapist identified disorders both of impressive and expressive speech. The patient had difficulties understanding and implementing complex instructions. Showing real objects, objects in the picture and body parts was possible for three elements. The volume of verbal memory had been reduced. The patient demonstrated difficulties in understanding logical-grammatical constructions (in terms of Luria), metaphors, proverbs, and texts. Phonemic perception was initially impaired. Mistakes of audioverbal gnosis, alienation of word meaning, as well as observed difficulties in switching audioverbal attention were also present. Spontaneous speech was presented in short sentences, with pauses and verbal paraphasias (replacements) due to word-finding difficulties. Speech activity was reduced, speech lexicon was presented by frequent vocabulary, nominative and verbal deficits were observed. In the repetition task, there were replacements based on acoustic sound proximity, insertions,

and difficulties in pronouncing phonetically complex words. Increase in the period of actualization of the right word and verbal paraphasias (replacements) were observed. Difficulties in phrase-making manifested in semantic and associative slippage.

The speech therapist diagnosed Wernicke's aphasia of moderate severity. The results of the Quantitative Assessment of Speech Symptoms in Aphasia (Tsvetkova et al., 1981) are shown in Table 1. The maximum score for all subtests except Telling a Story is 30.

The patient had no disorders of non-verbal mental functions, such as manual or oral praxis, visual perception and memory, or executive functions diagnosed by a neuropsychologist.

Experimental neuropsychological tasks

At the first stage, all participants were given tests that are included in a comprehensive neuropsychological examination with the method of Luria. The purpose of this diagnostic kit was to identify a syndrome of Wernicke's (sensory) aphasia and agraphia as well as the assessment of other mental functions. Comprehensive examination allowed exclusion of patients with disturbances that make the assessment of the primary writing disorders difficult: symbolic agnosia, disorders of executive functions, gross neurodynamic disturbances.

Then, eligible patients were presented with specially designed experimental tasks, actualizing different cultural-historical functions of writing. Experimental tasks required the implementation of holistic, meaningful forms of human activity and actualized communicative, mnemonic, and regulatory functions of writing. None of the patients suspected that the real object of the study was their writing ability.

Table 1
Quantitative Assessment of the Speech of Patient P.

	Score	Range
Expressive speech		
Dialogue	27	0–30
Object naming	25	0–30
Action naming	24	0–30
Sentence making	21	0–30
Telling a story	4	
Impressive speech		
Dialogue comprehension	30	0–30
Objects comprehension	28	0–30
Actions comprehension	27	0–30
Phrases comprehension	23	0–30
Instructions comprehension	26	0–30

The task actualizing the communicative function was to perform written communication with the social service of the clinic. Patients were asked to describe in their letter their social status: information on their place of residence, educational institutions, job profiles, their level of well-being, and their family.

Mnestic function was actualized in the task, Remembering the Picture. For this purpose, patients were presented pictures with many details depicting scenes from country life. All pictures differed from each other in minor details. Patients were asked to remember the content of one of the images in order to distinguish this image a week later from 15 similar pictures; however, the new picture would be different from the original by one detail only. Thus, patients had to resort to writing to hold the required volume of information over a long period. The need for writing was provoked naturally and the patients did not suspect that writing was the true object of the study.

Actualization of the regulatory function was achieved in drafting a plan before performing experimental tasks of varying difficulty. Patients had to perform the maximum possible number of tasks under time pressure. At the beginning of the study, a large number of tasks were laid out on the desk in front of a patient (for example, finding differences between pictures, picking words from syllables, correction sample, etc.). The participants were instructed that the time to complete the tasks would be limited to 30 min and therefore it was necessary to distribute tasks according to their degree of difficulty, starting with the simplest one. To perform the maximum number of tasks in the allotted time, the patients started with the easiest, and then moved on to the more complex ones. To maximize the effectiveness of their work, the patients needed to make up a plan before starting work, in order to avoid wasting time on thinking when choosing tasks. Thus, the patients had no idea that the object of the study was their writing production, rather than the effectiveness of tasks performance. Conditions for the fulfillment of all tasks and absence of direct indication of the necessity to write disguised the essence of the investigated process from the participants and reduced the influence of the setting behavior and intentions of the patients on the productivity of writing.

All tasks were equalized with each other in terms of involved components of writing. They represent the process of spontaneous writing, but with different intentions. In other words, all the structural stages of this writing process (creating the main idea, choosing the words and their order,

phoneme-to-grapheme conversion, controlling their actions and so on) were equal in all three experimental tasks. Thus, it was assumed that all of the tasks were equal in their psychological structure from the point of the most influential theoretical perspectives (Beauvois & Dérouesné, 1981; Bub & Kertesz, 1982; Caramazza, 1988; Coltheart & Caramazza, 2006; Coltheart et al., 2001; Ellis, 1982; Houghton & Zorzi, 2003; Lichtheim, 1885; Luria, 1950, 1973, 2002; Luzzatti, 2008; Morton, 1969, 1980; Rapcsak et al., 2007, 2009; Roeltgen, 2003; Shallice, 1981; Tainturier & Rapp, 2001; Tsvetkova, 2002). The list and the order of the psychological components were the same in all of these cases.

Below we describe component composition of the experimental tasks in terms of psychological structure of speech system by Luria (1950, 2008 as well as a widespread cognitive dual route model of writing.

The first structural component of writing according to Luria is an intention to write, in other words, realization of a certain goal by writing. The patients wrote letters to inform the social service, created texts in order to remember pictures or control their actions, and in all cases, patients were able to formulate the content of the text and the strategy of their work freely.

The next stage of writing was associated with memory processes, and included remembering the ideas that were to be written and retaining the necessary sequences of words that the patients also performed on their own. Control over retaining the intended phrase unchanged was also implemented freely by the regulatory component of writing. Then, an idea was connected to each phrase, which suggested actualization of individual words.

The next structural component was the most specific to writing as a kind of speech function and engaged processes of phonetic analysis of words. At this stage, the speech flow was divided into sounds and these sounds were converted into phonemes. In all three tasks, an analysis of oral speech during the implementation of a writing function was not required. So, there was no additional load on the acoustic analysis of oral speech, such as the one that happens, for example, during writing to dictation, which is critical for patients with Wernicke's agraphia. The next stage is the process of phoneme-to-grapheme conversion. During conversion of a phoneme to a grapheme, its topology and the spatial arrangement of its elements are taken into account. Since the choice of individual words to be written was not regulated externally and depended solely on the patient, we can consider the complexity of the graphic characters to be the same for each patient in three experimental tasks. The next stage, such as motor (kinetic) programming of sound sequences, was consistent in all tasks because the choice of specific words and their complexity was entirely dependent on the patient.

We will now describe spontaneous writing in all three tasks from the perspective of a modern cognitive model for reading and writing—the dual-route model. The first phase of spontaneous writing is the semantic system that stores knowledge about the world, and keeps word meanings, and forms the future utterance (Morton, 1969). Since in all cases the patients independently created the future content of the text, the semantic system in all three tasks had to be an initial component of writing. Further, according to the dual-route model, information from the semantic system enters either the output phonological lexicon or the graphemic output lexicon. The choice of the lexicon depends on the degree of regularity of a specific word of the language.

In the case of writing words with regular spelling, information from the semantic system enters the output phonological lexicon and actualizes a holistic speech sound image corresponding to a given word. Then, this holistic sound image is divided into individual phonemes that are retained in a certain order in the short-term memory, which is called phonemic buffer. From the phonemic buffer there is only one way—to block the phoneme-to-grapheme conversion. After the conversion, graphemes should also be kept in a certain order in the short-term memory during their generation in the act of writing. This operation is performed by the output graphemic buffer.

In the case of writing irregular words, knowledge of the correct word spellings is necessary. This knowledge is contained in the output grapheme lexicon, whereas in the output phonological (sound) lexicon, morphemes of words are stored. However, the output graphemic lexicon, unlike the phonological one, stores graphemic images of familiar words and therefore knowledge of the correct spelling of a word. From the output graphemic lexicon, graphemic images of words enter the output graphemic buffer, and both routes for writing—relying on the knowledge of the correct spelling or direct phoneme-to-grapheme conversion—are joined. Both lexical routes—for regular and irregular words—are commonly used for writing words that are familiar to the writer.

Following the output graphemic buffer, a series of operations that remain the same during any act of writing is performed. The first of these components is a buffer of

allograms. This component stores the information about the registers and fonts of letters (handwriting and print, for example). This is followed by a buffer of motor diagrams, which contains motor automatisms implementing the process of writing. These integral synergies later happen in sequence with individual neuromuscular coordination that has directly implemented the motor act of writing.

As we can see from this model, separation of ways for spontaneous writing depends on the regularity of words that are to be written. Since patients use existing words of language, the regularity of which is not determined by external factors in all three experimental tasks (there were no dictated words, there was no need for use of certain words in the text), we can assume that average regularity of chosen words in all tasks was equal.

The following stages of writing, as mentioned earlier, do not depend on the writing task type and remain the same for all writing acts.

However, in addition to the described embodiments of lexical routes, there are situations where a person needs to write the word, the pronunciation of which he knows, but is not sure of the correct spelling. For such words, there are no corresponding representations in the output graphemic lexicon, and the mechanism of straight phoneme-to-grapheme conversion is needed. This route is implemented from the semantic system to the output phonological lexicon, then to the phonemic buffer and through the mechanism of phonemic–graphemic conversion to the output graphemic buffer. Since the choice of words was dependent on participants, the cases in which patients had to write words that were familiar to them only phonologically could equally occur in all three types of tasks. Moreover, all tasks were normalized for linguistic criteria. To improve the accuracy and reduce the ambiguity of the interpretation of the writing disorder in a variety of writing tasks, variables such as the lexical frequency and phonetic complexity of words were controlled. However, it was not possible to directly regulate any linguistic parameters (lexical frequency of words, phonetic complexity, syllable structure, etc.) in the experimental task because the ways to achieve the goal of communication, memory, or the regulation of activity were entirely dependent on the participants. Since the same participants performed all three tasks, it was assumed that in intraindividual comparison, the choice of linguistic parameters in all tasks would be equal.

However, to make such an assertion, it was necessary to be sure that the proposed stimulus material did not provoke changes in the use of linguistic tools. So a comparison of the lexical frequency and phonetic difficulty was conducted in an additional study preceding the main experiment. This study revealed the dispersion of linguistic parameters and allowed for the evaluation of the possible impact of the lexical frequency of stimulus material on changes in frequency of words chosen by participants. In case of coincidence of phonetic complexity and lexical frequency in all tasks and no effect of frequency of stimulus material, the uniformity of linguistic parameters in all tasks can be inferred.

In spite of the impossibility to directly affect the production of the participants, to prove the assumption that the tasks were normalized on linguistic criteria, we organized an experiment to vary the linguistic parameters of stimulus material. As a result, changes in frequency and phonetic complexity of words were not observed, which confirms that all parameters were controlled and normalized. This additional study involved 11 participants chosen by the same inclusion criteria as for participants in the experimental group (see Description of the group of participants section). Mean age was 54 ± 10.13 years (range, 36–69), there were eight males and three females. Ten patients had higher education; one had secondary vocational education.

The participants were offered four tasks—communicative, regulatory, and two mnestic tasks. Three of the four tasks were subsequently included in the main study. The second mnestic task was aimed at assessing the impact of the frequency of stimulus material on change (decrease) of lexical frequency of the picture description. For this purpose, a second set of images containing the low-frequency images was offered. Lexical complexity was determined by the frequency dictionary of the modern Russian language (Lyashevskaya & Sharov, 2009). Phonetic complexity was calculated by the formula proposed in the Quantitative Assessment of Speech Symptoms in Aphasia by Tsvetkova et al. (1981): phonetic complexity = $1 \times$ (number of consonants) + $1 \times$ (number of consonant clusters) + $0.5 \times$ (number of closed syllables). Words with a score of less than 3.5 points are considered simple, those that are above this threshold are considered complex. The lexical frequency range of words in the tasks was 36–623 with a median score of 130. The range of phonetic complexity was from 2.5 to 4 points. The percentage of phonetically simple words was 31%.

Friedman's test showed no significant differences in the distribution of the lexical frequency of words by comparing two sets of mnestic task ($p = .625$). The lack of effect of

low frequency and higher phonetic complexity of stimulus material to written production was due to the simplification of complex words and replacement of them with simpler synonyms. For example, when describing the cobwebs in the corner of the room, some patients called it a "spider's house," and "round jar" was used instead of "aquarium." Thus, the written words do not differ in frequency, and accordingly, differences in the number of errors were not associated with the actualized lexicon.

Procedure

For the formation of the experimental group at the first meeting with the participants, a comprehensive neuropsychological examination was conducted (Luria, 1973, 2008; Khomskaya, 1987). The severity of speech disorders was determined using the method of assessment of the severity of speech disorders by Tsvetkova et al. (1981). At the next meeting with the patient, experimental tasks were presented. To monitor the effect of the sequence, all of the tasks were represented in accordance with the scheme of a balanced Latin square design. This is a method of partial equalizing of test conditions when their number is too big. The balanced design was invented in order to account for the first-order carry-over effects (e.g. learning, fatigue, contrast). The balanced Latin-square design follows a designated algorithm that decides on the sequence in which manipulations will be executed. With a size of three conditions, a balanced Latin square design will look as follows: A B C B C A C A B C B A A C B B A C.

Data analysis

Error distribution in the experimental group

Analysis differed between the group study and the single-case study. First, we will describe the method for detecting differences between the tasks in the total number of errors in the group. Errors in all written tasks were divided into 10 types: literal paragraphias, insertions, transpositions, anticipations, verbal paraphasias, omissions, unfinished words, spelling errors, multiple literal paragraphias due to sound lability, and perseverations. Literal paragraphias are replacements of one grapheme for another. Insertions are additions of an extra grapheme into the word. Transpositions are grapheme replacements within a word. Anticipations, as opposed to insertions, are made by the graphemes of the same or the next word (комната/комнамта). The next type of error, verbal paragraphias, is the replacement of one word for another. In the case of omission, not all letter places in the word are filled (инженер/иненер). Unfinished words are ones in which the end and/or suffix is missing (библиотека/библиоте). We classified as spelling errors the errors associated with the implementation of the principle of phonological writing, in cases of phonetic reduction of unstressed vowels (корова/карова), as well as missing sounds in consonant clusters (грамматика/граматика). Multiple literal paragraphias were usually observed in patients with more severe defects and were the result of a sound lability. Also in the analysis we included patients with unspecific Wernicke's agraphia error—perseveration. Typically, such errors were manifested as extra touches when writing letters.

To preserve the internal validity of measurements, some limitations were introduced: Syntactic errors were not taken into account. Such errors were attributed by replacement of prepositions and errors in flexions, indicating gender and number of verbs, nouns and pronouns. The observed disturbances were related to the agrammatism phenomena observed at the level of the surface syntax (Akhutina, 2007). Exception of syntactic errors was made due to the different requirements for the syntactic structuring of written production in the experimental tasks, and because grammar was not the aim of the investigation. Writing a letter to a social service implied unfolded phrases, while the description of the image could be replaced by naming its parts (e.g.: "Geese, 2; near the dog, 1").

The first step of data analysis was calculation of the absolute number of errors of each type (literal paragraphias, omissions, transpositions, etc.) in each task. Then, this value was divided by the number of words in a particular task. This result is the ratio of the absolute number of errors of a certain type (e.g., literal paraphasias) to the number of words in the task (for example 56 words in a communicative task). We called this the error rate (in this case, the rate of literal paragraphias). In the same way, error rates were counted for other types of errors. Using the error rates, but not the absolute values, allowed us to include all written production into the analysis despite the fact that the number of words in different tasks was different. Then a comparison of the total number of error rates of each type in every written task (e.g. error rate of literal paragraphias in communicative task plus error rate of omissions in communicative task, etc.) was conducted. In other words, for each participant we summed error rates of all selected types within a single writing task. These summed error rates were used in the statistical analysis. Since the distribution of error rates did not

correspond to the normal distribution for any kind of error, our statistical analysis used the non-parametric Friedman's rank test. Besides the summed error rate, similar non-parametric Friedman's rank tests were conducted separately for each type of error rate as well.

Error distribution in a single patient

We also present the error analysis between tasks carried out on single-patient data. Selecting this patient was due to the presence of maximum error differences for certain types of errors in the three tasks (see Figure 1). As it follows from Figure 1, "visual inspection" indicates that this patient has to be treated differently, being an outlier, because she would increase the variance of the group; thus, this patient has to be treated as a single case.

To analyze this single subject's data, we separately calculated the absolute number of error rates in each error type for the first word in the three tasks, then for the second word in the three tasks, and so on. In this case, the number of words in each task serves as the sample size. In order to examine whether there exist differences among the three tasks, separate Kruskal–Wallis one-way analysis of variance tests were conducted for each type of error rate. Thus, we compared the distribution of error rates of each type in written assignments.

Statistical analysis was performed using IBM SPSS Statistics V22.0.

Results

Analysis of errors distribution in the experimental group

Friedman's rank test on the summed error rate of the three tasks did not show significant difference among tasks, $\chi^2 = 2.26$, $p = .323$. Separate analyses on each type of error rate using a similar method did not show any task difference either, all ps $> .05$. Thus, no task difference was revealed with the group data (see Figure 2).

Analysis of errors distribution in a single patient

Kruskal–Wallis one-way analysis of variance for each type of error rate for Patient P. revealed significant differences in the number of literal paragraphias between the mnestic and regulatory tasks ($\chi^2 = 2.75$, $p = .097$; see Figure 1). The number of other types of errors, except literal paragraphias and omissions, was too small for statistical calculations (see Figure 1). A comparison of the error rates of literal paragraphias for communicative and mnestic and for communicative and regulatory tasks did not reach a level of significance ($\chi^2 = 1.93$, $p = .165$; $\chi^2 = 1.46$, $p = .227$). The most revealing difference in the number of omissions was identified by comparing the mnestic and regulatory tasks, but they were not significant either ($\chi^2 = 2.20$, $p = .138$).

Discussion

Error distribution in the experimental group

Analysis of the different types of errors in the writing tasks showed no significant differences in the experimental group. This result can be explained by the assumption that the structure of writing disorder when performing different culturally determined tasks remains the same. At the same time, the result can also be interpreted in a way that the important differences between the experimental tasks may be hidden due to statistical averaging.

So, group data analysis shows that the manifestations of writing disorders in Wernicke's agraphia did not change during implementation of different cultural writing tasks, which does not confirm our initial hypothesis.

Error distribution in a single patient

Analysis of the total number of errors in written tasks in the single patient showed one significant difference—the prevalence of literal paragraphias in the mnestic task compared with the regulatory task. Let us discuss what might explain this difference.

Since all tasks were equalized with each other in their psychological structure, it is hard to explain differences in the number of errors of certain types by the composition writing components (see Experimental neuropsychological tasks section). Consequently, another explanation should be presented, so the following steps of argumentation were held. The meaning of experimental tasks generates different strategies in a participant's writing activity, which determines the method of using psychological components. As a result of applying these strategies, the difference of the total number of words used in the experimental tasks was detected. A greater number of words in the mnestic task leads to extra deficiency of phonological processing and therefore to an increase of literal paragraphias compared with the regulatory task. Let us discuss this way of reasoning in more detail.

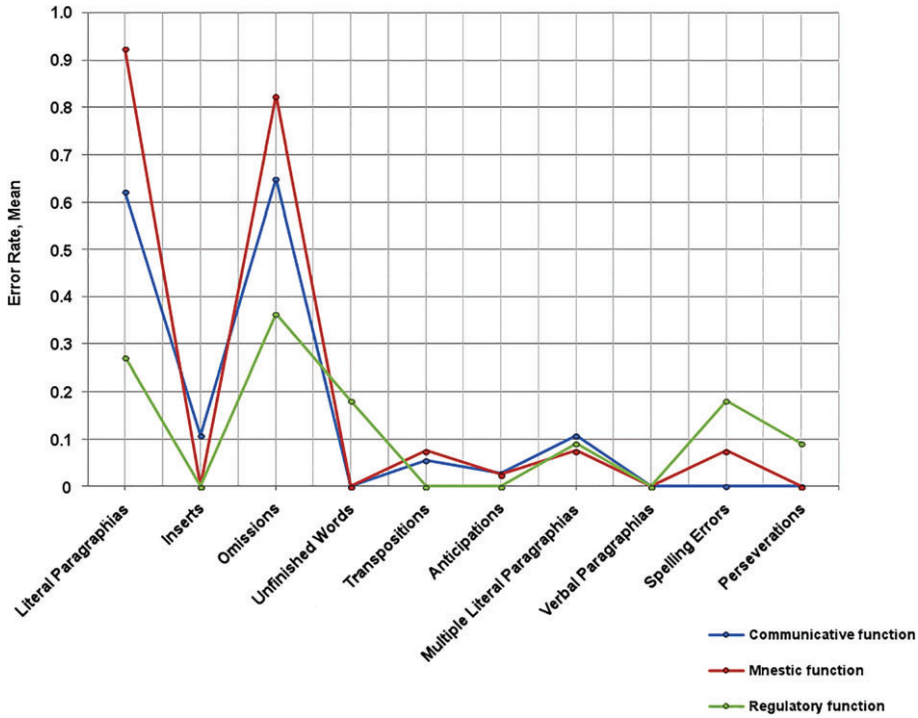

Figure 1. Distribution of error rates in writing tasks (single patient's data).

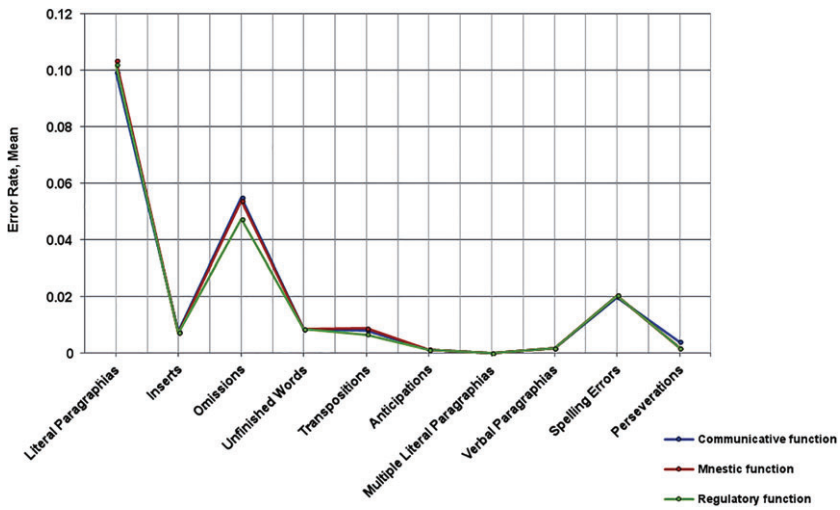

Figure 2. Distribution of error rates in writing tasks (group data).

The accuracy and completeness of information were not a priority in the regulatory task in comparison with the tasks that actualize communicative and mnestic functions. Performing the task of letter writing, the participant had to communicate with the actual missing subject and therefore tried to express her thoughts accurately and fully. Storing the content of the picture in the mnestic task could be carried out as a concise form as well. As distractors were very similar to the stimulus image, it is more plausible that only a detailed description would help the participant to distinguish stimulus from distractors. It should also be borne in mind that, according to the mnestic task, the participant had to remember the key stimulus after a long period of time, that is, after a week. In the condition of long-term retention, the patient had to describe in detail the picture to be able to recognize it among similar distractors over a long time interval.

On the contrary, in the regulatory writing task, the participant's addressee was herself rather than another person and this written production was used immediately after writing. It is also important to note that the regulatory task was performed under time pressure. It is possible that the

features of the regulatory task, mentioned just above, increased the number of spelling errors and unfinished words. However, these mistakes were not the obstacles for the patient in the identification of the words that she had written. So the task could be completed successfully. Thus, it can be concluded that the patient used the strategy that can be called the strategy of expediency, as there was no necessity to express thoughts accurately and fully. In spite of the fact that this strategy led to an increase in certain types of errors, it did not reduce the effectiveness of the task performance.

So, inaccuracy and reduction of written information are admissible in performing the regulatory task and led to the threefold decrease in the total number of words compared with the two other tasks (12 words in the regulatory task, 36 in the communicative and 47 in the mnestic).

At the same time, the patient could not follow this strategy in other tasks: She had to express her thoughts accurately and fully, as it was argued earlier. The fact that the patient used many more words in the mnestic tasks than in the regulatory task should be considered as the cause of the prevalence of literal paragraphias in the mnestic task. It can be assumed that if a participant generates a lot of lexical production, it demands a high level of capacity from the particular language mechanisms that are damaged in sensory (Wernike) aphasia, that is, the mechanisms that are responsible for the stability of phonological words' images. In these circumstances, it is quite expected that in a mnestic task, the number of literal paragraphias increases significantly. This type of error, when the word's graphemes are replaced frequently, reflects the defect of phonological word stability in sensory (Wernike) aphasia. Thus, the strategy of expediency in the regulatory task on the one hand, and the high pressure on phonological word stability in the mnestic task on the other, could be the two main converging reasons of observed significant difference of literal paragraphias in these two experimental conditions.

However, this assumption is not enough to explain the absence of the analogous difference between the regulatory and the communicative tasks. The communicative task, as well as the mnestic one, requires extensive word production, so it is reasonable to expect the prevalence of literal paragraphias in the communicative task, compared with the regulatory task. Nevertheless, the similarities between communicative and mnestic conditions are not as comprehensive as they seem. The important specific in psychological strategies used in these tasks can be discussed again. In the mnestic task, the patient had to work with the presented pictures and therefore with lexical material that was determined by the experimenter. The patient was very limited in choosing the words to write, as they had to correspond with the images in the picture. On the contrary, in the communicative task, the patient was free to choose the topics of her message and consequently, she used words that are deemed appropriate. Moreover, if the participant had doubts about her ability to write the particular word correctly, she could always change it to another one, which was simpler from her point of view. This freedom in using lexical material, which could be called the strategy of variability, can explain why there were not as many literal paragraphias in the communicative task as in the mnestic one and why the significant difference in this type of error was not detected between regulatory and mnestic tasks, but between regulatory and communicative tasks.

It should be repeated at the end of this section that this specific in psychological strategies can hardly be explained by structural differences of communicative and mnestic tasks, as they were equalized in structural and linguistic parameters. The usage of variability strategy as the strategy of expediency was determined by the meaning of the tasks. Thus, the observed reorganizations of agraphia syndrome can be explained in the framework of the meaningful and holistic forms of human activity, which perform a variety of culturally established functions of writing. In this context, a single case can be used to develop the theory of the psychological functions and its pathology, in particular, in organic brain lesions. It has been shown that the symptoms of writing disorders can be explained in terms of a holistic approach that does not reject the component structure of writing, but opens the possibility of changing components' features, depending on the task.

Conclusion

In this article we have analyzed the role of a single case study compared with averaged group data in the study of theoretical concepts of written language and its disturbances in agraphia. Investigating the subject in its pure form makes it possible to realize the Socratic function of theoretical dialogue, when manifestation of the phenomenon is not just a confirmation of the hypothesis or falsification of the contradicting position, but preserving the achievements of the opponents in the capacity of special cases of a new, more general, theoretical frame. The

theoretical dialogue of this kind took place between elementaristic, holistic (Gestalt), and cultural-historical approaches in psychology. This fact makes possible an attempt to reconstruct the discussion in the field of neuropsychology, analyzing the single case of sensory agraphia.

From this perspective, the structural components of writing and its disorders as symptoms of agraphia can change their properties and sense in the context of a particular psychological whole, which is organized by cultural-historical functions of writing. Therefore, during neuropsychological investigation and assessment, writing and other psychological functions should be considered as meaningful forms of human activity that are holistic and cultural-historical in nature.

References

Akhutin, A. V. (1976). *Istorija principov fizicheskogo jeksperimenta: Ot Antichnosti do XVII veka* [History of the principles of physical experiment: From antiquity to the 19th century]. Moscow: Nauka.

Akhutina, T. V. (2007). *Porozhdenie rechi: Nejrolingvisticheskij analiz sintaksisa* [Generation of speech: Neurolinguistic analysis of syntax]. Moscow: LKI Publishers.

Anokhin, P. K. (1935). *Problema tsentra i periferii v sovremennoy fiziologii nervnoy deyatelnosti: Problema tsentra i periferii v nervnoy deyatelnosti* [The problem of center and periphery in the modern physiology of nervous activity: The problem of center and periphery in the nervous system]. Gorkiy: Gorkovskoe izdatelstvo.

Anokhin, P. K. (1955). *Obschie printsipyi kompensatsii narushennyih funktsiy i ih fiziologicheskoe obosnovanie* [General principles of compensation of disturbed functions and their physiological basis]. Moscow: Meditsina.

Anokhin, P. K. (1971). *Printsipialnyie voprosyi obschey teorii funktsionalnyih system* [Fundamental questions of the general theory of functional systems]. Moscow: Nauka.

Anokhin, P. K. (1975). *Ocherki po fiziologii funktsionalnyih system* [Essays on the physiology of functional systems]. Moscow: Meditsina.

Assmann, H. (2004). *Kulturnaya pamyat: Pismo, pamyat o proshlom i politicheskaya identichnost v vyisokih kulturah drevnosti* [Cultural memory: Writing, the memory of the past and political identity in the high cultures of antiquity]. Moscow: Yazyiki slavyanskoy kulturyi.

Beauvois, M. F., & Dérouesné, J. (1981). Lexical or orthographic agraphia. *Brain*, *104*, 21–49. doi:10.1093/brain/104.1.21

Bernstein, N. A. (1991). *O lovkosti i ee razvitii* [About dexterity and its development]. Moscow: Izdatelstvo "Fizkultura i sport" Gosudarstvennogo komiteta SSSR po pechati.

Bernstein, N. A. (2008). *Biomehanika i fiziologiya dvizheniy* [Biomechanics and physiology of movement]. Moscow: SAG.

Brudnyi, A. A. (1972). *Semantika yazyika i psihologiya cheloveka* [The semantics of language and human psychology]. Frunze: Ilim.

Bub, D., & Kertesz, A. (1982). Deep agraphia. *Brain and Language*, *17*, 146–165. doi:10.1016/0093-934X(82)90011-6

Caramazza, A. (1988). Some aspects of language processing revealed through the analysis of acquired aphasia: The lexical system. *Annual Review of Neuroscience*, *11*, 395–421. doi:10.1146/annurev.ne.11.030188.002143

Coltheart, M., & Caramazza, A. (Eds.). (2006). *Cognitive neuropsychology twenty years on*. Hove: Psychology Press.

Coltheart, M., Rastle, K., Perry, C., Langdon, R., & Ziegler, J. (2001). DRC: A dual route cascaded model of visual word recognition and reading aloud. *Psychological Review*, *108*(1), 204–256. doi:10.1037/0033-295X.108.1.204

Doblhofer, E., & Friedrich, I. (2002). *Istoriya pisma: Evolyutsiya pisma ot drevnego Egipta do nashih dney* [The history of writing: Evolution of writing from ancient Egypt to the present day]. Moscow: Publishing House Eksmo; St. Petersburg: Terra Fantastica.

Ellis, A. W. (1982). Spelling and writing (and reading and speaking). In A. W. Ellis (Ed.), *Normality and pathology in cognitive function* (pp. 113–146). London: Academic Press.

Finger, S. (1994). *Origins of neuroscience: A history of explorations into brain function*. Oxford: Oxford University Press.

Goldstein, K. (1942). *Aftereffects of brain injuries in war: Their evolution and treatment*. London: William Heinemann Medical Books.

Goldstein, K. (1948). *Language and language disturbances: Aphasic symptom complexes and their significance for medicine and theory of language*. New York, NY: Grune and Stratton.

Goldstein, K., & Scheerer, M. (1941). Abstract and concrete behavior – an experimental study with special tests. *Psychological Monographs*, *53*(2), 1–151. doi:10.1037/h0093487

Goodglass, H. (1993). *Understanding aphasia*. San Diego, CA: Academic Press, Inc.

Head, H. (1963). *Aphasia and kindred disorders of speech* (Vol. 1). New York, NY and London: Hafner Publishing Company.

Houghton, G., & Zorzi, M. (2003). Normal and impaired spelling in a connectionist dual-route architecture. *Cognitive Neuropsychology*, *20*(2), 115–162. doi:10.1080/02643290242000871

Istrin, V. A. (1965). *Vozniknovenie i razvitie pisma* [The origin and development of writing]. Moscow: Nauka.

Jackson, J. H. (1878). On affections of speech from disease of the brain. *Brain*, *1*, 304–330. doi:10.1093/brain/1.3.304

Jean, J. (2005). *Istoriya pismennosti i knigopechataniya* [The history of writing and book printing]. Moscow: AST Astrel.

Keller, W. (1998). *Issledovanie intellekta chelovekopodobnyih obezyan* [Study of apes' intelligence]. Moscow: AST-LTD.

Khomskaya, E. D. (1987). *Neyropsihologiya* [Neuropsychology]. Moscow: Izd. University Press.

Kliks, F. (1983). *Probuzhdayuscheesya myishlenie: U istokov chelovecheskogo intellekta* [Wakes up thinking: At the root of human intelligence]. Moscow: Progress.

Koffka, K. (1998). *Osnovy psihicheskogo razvitiya* [Fundamentals of mental development]. Moscow: AST-LTD.

Kussmaul, A. (1879). *Rasstroystva rechi: Opyit patologii rechi* [Disorders of speech: Experience of speech pathology]. Kiev: Publication Doctor B. A. Havkin.

Lashley, K. S. (1929). *Brain mechanisms and intelligence*. Chicago, IL: University of Chicago Press.

Leontiev, A. N. (1981). *Problemi razvitiya psichiki* [Problems of psyche genesis]. Moscow: Moskovskiy Gosudarstvennyiy Universitet.

Leontiev, A. N. (1994). *Filosofiya psihologii* [The philosophy of psychology]. Moscow: Moskovskiy Gosudarstvennyiy Universitet.

Leontiev, A. N. (2004). *Deyatelnost. Soznanie. Lichnost* [Activity. Consciousness. Personality]. Moscow: Meaning.

Lewin, K. (2001). *Dinamicheskaya psihologiya* [Dynamic psychology]. Moscow: Meaning.

Liaudis, V. Y., & Negure, I. P. (1983). *Psihologicheskie osnovyi formirovaniya pismennoy rechi u mladshih shkolnikov* [Psychological bases of formation of writing in primary school children]. Chisinau: Shtiints.

Lichtheim, L. (1885). On aphasia. *Brain*, *7*, 433–484. doi:10.1093/brain/7.4.433

Likhachev, D. S. (1951). Istoricheskie predposyilki vozniknoveniya russkoy pismennosti i russkoy literaturyi [Historical predictors of Russian literature and Russian literature]. *Voprosyi Istorii*, *12*, 30–55.

Luria, A. R. (1947). *Travmaticheskaya afaziya* [Traumatic aphasia]. Moscow: Publishing House of the Academy of Medical Sciences CSCP.

Luria, A. R. (1950). *Ocherki psihofiziologii pisma* [Essays of writing psychophysiology]. Moscow: Publishing House of the RSFSR.

Luria, A. R. (1973). *Osnovyi neyropsihologii* [Basics of neuropsychology]. Moscow: Izd. University Press.

Luria, A. R. (2002). *Pismo i rech: Neyrolingvisticheskie issledovaniya* [Writing and speaking: Neurolinguistic research]. Moscow: Academy.

Luria, A. R. (2008). *Vyisshie korkovyie funktsii cheloveka* [Higher cortical functions in man and their impairment in local brain lesions]. Moscow: Academic Project.

Luzzatti, C. (2008). Acquired reading and writing disorders. In B. Stemmer & H. A. Whitaker (Eds.), *Handbook of the neuroscience of language* (pp. 209–218). San Diego, CA: Academic Press.

Lyashevskaya, O. N., & Sharov, S. A. (2009). *Chastotnyiy slovar sovremennogo russkogo yazyika (na materialah natsionalnogo korpusa russkogo yazyika)* [Frequency dictionary of modern Russian language (on materials of the Russian National Corpus)]. Moscow: Azbukovnik.

Mazunova, L. K. (2006). *Pismo kak sposob i sredstvo sohraneniya fenotipa «chelovek kulturnyiy»* [Writing as a way and means of maintaining phenotype "man of the world"]. Moscow: Science.

Morton, J. (1969). Interaction of information in word recognition. *Psychological Review*, *76*(2), 165–178. doi:10.1037/h0027366

Morton, J. (1980). The logogen model and orthographic structure. In U. Frith (Ed.), *Cognitive processes in spelling* (pp. 117–133). London: Academic Press.

Rapcsak, S. Z., Beeson, P. M., Henry, M. L., Leyden, A., Kim, E., Rising, K., … Cho, H. (2009). Phonological dyslexia and dysgraphia: Cognitive mechanisms and neural substrates. *Cortex*, *45*(5), 575–591. doi:10.1016/j.cortex.2008.04.006

Rapcsak, S. Z., Henry, M. L., Teague, S. L., Carnahan, S. D., & Beeson, P. M. (2007). Do dual-route models accurately predict reading and spelling performance in individuals with acquired alexia and agraphia? *Neuropsychologia*, *45*(11), 2519–2524. doi:10.1016/j.neuropsychologia.2007.03.019

Roeltgen, D. (2003). Agraphia. In K. M. Heilman & E. Valenstein (Eds.), *Clinical neuropsychology* (pp. 126–143). New York, NY: Oxford University Press.

Shallice, T. (1981). Phonological agraphia and the lexical route in writing. *Brain*, *104*(3), 413–429. doi:10.1093/brain/104.3.413

Skvortsov, A., & Romaschuk, A. (2015). Single case studies as a means for developing psychological theories. *PsyCh Journal*, *4*, 231–242. doi:10.1002/pchj.117

Tainturier, M.-J., & Rapp, B. (2001). The spelling process. In B. Rapp (Ed.), *The handbook of cognitive neuropsychology: What deficits reveal about the human mind* (pp. 263–289). Philadelphia, PA: Psychology Press.

Taylor, J. (Ed.). (1932). *Selected writings of John Hughlings Jackson:* Vol. 2. *Evolution and dissolution of the nervous system. Speech, various papers, addresses and lectures*. London: Hodder and Stoughton.

Tsvetkova, L. S. (2002). *Afaziologiya: Sovremennyie problemyi i puti ih resheniya* [Aphasiology: Current problems and solutions]. Moscow: Moskovskiy Psihologo Sotsialnyiy Institute.

Tsvetkova, L. S., Akhutina, T. V., & Pylaeva, N. M. (1981). *Metodika otsenki rechi pri afazii* [Method of quantitative assessment of the speech symptoms in aphasiaology to evaluate speech in aphasia]. Moscow: Moskovskiy Gosudarstvennyiy Universitet.

Vinarskaya, E. (2007). *Klinicheskie problemyi afaziy* [Clinical problems of aphasia]. Moscow: Sekachev.

Vizel, T. G. (2002). *Nejrolingvisticheskij analiz atipichnyh form afasij* [Neurolinguistic analysis of atypical forms of aphasia] (Unpublished PhD thesis). Moskovskiy nauchno-issledovatelskiy institut psihiatrii, Moscow.

Vygotsky, L. S. (1983). *Problemyi razvitiya psihiki* [Problems of mental development] (Vol. *3*). Moscow: Pedagogika.

Wertheimer, M. (1980). *O geshtaltteorii: Hrestomatiya po istorii psihologii* [About Gestalt theory: Readings on the history of psychology]. Moscow: Moskovskiy Gosudarstvennyiy Universitet.

Zinkovskaya, N. Y. (2005). *Yazyik pismo kultura* [Language. Writing. Culture]. Novosibirsk: Izdatelstvo Novosibirskogo Gosudarstvennogo Tehnicheskogo Universiteta.