REVIEW ARTICLE

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THE PAST AND FUTURE OF NEUROPSYCHOLOGY

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SUMMARY

The history of neuropsychology can be conceived in three conceptually and chronologically overlapping phases. The first phase, dominated by the dialectic between locationism and holism (antilocationism), focused on reducing the human mind to the activity of neural processors (locationism), or of the brain as a whole (holism). In the second phase, marked by the introduction of Luria's concept of dynamic systems, mind is derived from the interaction of dynamic neural systems, whose components are dispersed both horizontally and vertically, and the concept of syndrome becomes prominent. In the third phase, neuropsychologists have begun to look at the brain as part of a whole human being, who lives in a particular ecosphere and comes into contact with other human beings. This last phase, which also draws inspiration from Luria's work, has pushed neuropsychology into new fields of inquiry, such as personality and family dynamics. It has also been marked by a shift from product-based to process-based neuropsychology, and the emergence of quality of life as a goal and outcome measure in neuropsychological rehabilitation.

INTRODUCTION

All over the world contemporary neuropsychology is demonstrating a general tendency to replace state-based neuropsychology, which relates the brain-damaged individual's symptoms to the precise location of cerebral lesions, with a more dynamic, process-based neuropsychology, which analyzes the dynamics of the brain-behavior interaction (Tupper & Cicerone 1990, Glozman 1999a).

Fig. 1 represents these developments in neuropsychology through 3 overlapping and coexisting phases.

During the *first phase* in the development of neuropsychological theory, the emphasis was on the brain and its presumed direct relations to various specific behaviors; in the *second phase*, the structure of mental activity became the focus of attention, and afterwards its localization in the brain. *The third phase* of development in neuropsychology focuses on the interrelationship between the patient and her/his environment, integrating neuropsychological and ecological data.

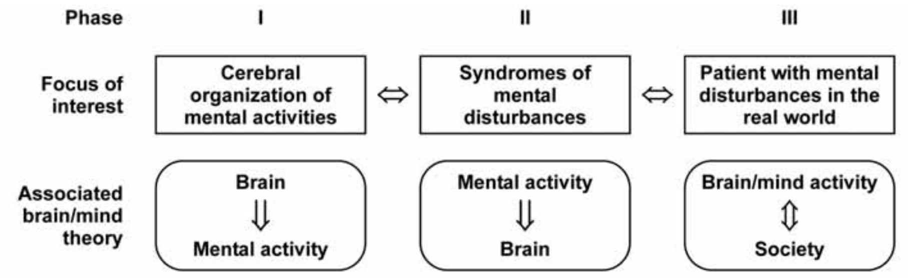

Fig. 1. A model of the development of neuropsychological theory

Let us analyze the first phase (Fig.2). The neuropsychology of this period was considered by Luria, as well as by Western neuropsychologists, to be a "field of practical medicine" (Luria 1973:17). The primary and most significant achievement of this phase was Luria's revision of the concepts of localizationism and antilocalizationism, and the creation of the theory of the dynamic and systemic cerebral organization of mental processes. This resulted in the functional analysis of different brain systems and the description of frontal, parietal, temporal and other syndromes. Recent developments following this approach have followed three main lines:

- studies of the functions of the right hemisphere and interhemispheric interactions in different types of memory, perception and reasoning, for compensating capabilities and others (Simernitskaya 1978; Korsakova & Mikadze 1982; Vasserman & Lassan 1989; Krotkova 1998; Homskaya & Batova 1998; Meerson & Dobrovolskaya 1998; Moskovich 2004; Schutz 2005);
- research in subcortical brain pathology, especially cognitive disturbances in patients with Parkinson's disease as compared to those with Alzheimer's disease. Voluntary (cortical) regulation is more impaired in AD than in PD patients. The evolution of PD and the progression of cognitive disturbances, up to the appearance of dementia, means a "corticalization"

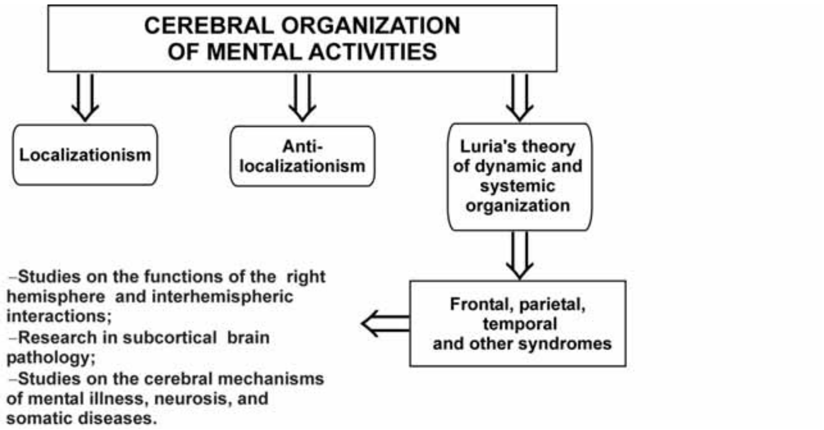

Fig. 2. The first phase in the development of neuropsychological theory

(cortex involvement) of the cognitive and executive disturbances. The evolution of Alzheimer's disease is due to the consecutive "frontalization" and "subcorticalization" of disturbances (Korsakova & Moskovichyute 1985; Glozman 1999a; Glozman et al. 2004; Bloom & Hynd 2005).

- studies of cerebral mechanisms of mental illnesses, neuroses, and somatic diseases, primarily schizophrenia, stuttering, recovery from heart surgery, exposure to radiation and others (Gorina & Kosterina 1996; Postnov et al. 1999; Korsakova 2005; Vartanov et al. 2005; Fioravanti et al. 2005).

The *second phase* gave birth to the concept of syndromes of mental disturbances, which affected the neuropsychology of memory disturbances (Luria 1976a; Korsakova & Mikadze 1982) and neurolinguistics (Luria 1976b, Akhutina 1981; Akhutina & Glozman 1995), along with many other fields of research. During this phase, new data were received concerning Wernicke's aphasia, pointing to its gnostic nature as a disconnection between the word and its corresponding image. It is not only that the patient cannot name an object, s/he cannot represent it, show it, or draw it (Kalita 1976).

The role of Polish neuropsychologists in the development of neurolinguistics should be stressed in this context. A significant international conference entitled "The linguistic study of aphasia" took place in Warsaw in 1975, and the 4th International Congress of Neurolinguistics was held in Cracow in 1994 (see Fig. 3).

Fig. 3. Some of the participants in the 4th International Congress of Neurolinguistics, held in Cracow, Poland, in 1994. At the center (6th from the left) is Harold Goodglass; to his right, the present author; to his left, Maria Pachalska, organizer of the Congress and presently Editor-in-Chief of *Acta Neuropsychologica*. Just behind the present author is Bożydar L. J. Kaczmarek, one of the Associate Editors of *Acta Neuropsychologica*

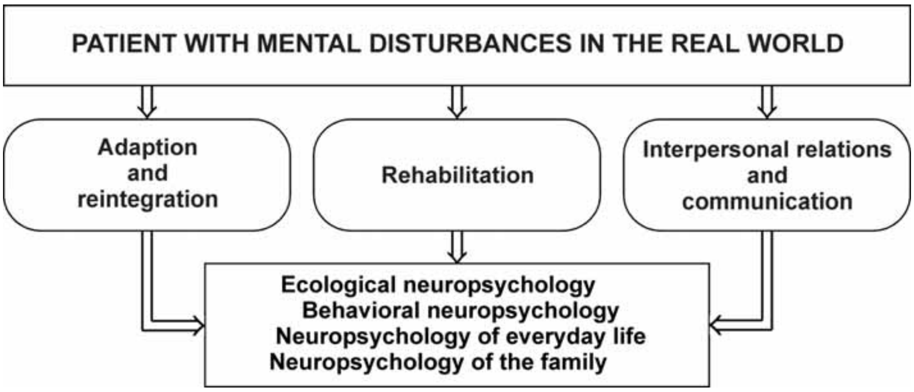

Fig. 4. The emergence of new fields of study in the third phase of the history of neuropsychology

Many of the syndromes occurring after cerebro-vascular pathology (Fig. 2) are a specific combination of "natural" brain alterations appearing with age, necessitating a change in strategies, voluntary selection, and the use of new forms of mediating mental activity and specific impairments caused by the disease (Korsakova 1998, Moskovich 2004). Syndromes of underdevelopment or atypical development reveal heterogeneity in the maturation of brain structures and connections, resulting in learning disabilities (Mikadze & Korsakova 1994; Akhutina 1998, 2001; Polyakov 2004). A new branch in neuropsychology studies mental dysfunctions in normal subjects in specific functional states or with some individual particularities or accentuations in cognitive performances. This last line of study has given birth to the neuropsychology of individual differences, which is an application of neuropsychological concepts and methods to the study of healthy subjects (Homskaya et al. 1997).

The third phase of development in neuropsychology (Fig. 4) focuses on the patient's adaptation and integration into society. Many standardized neuropsychological measures have been criticized for their poor ecological validity, that is, they fail to reflect the patient's actual performance in daily activities. The emphasis in assessment is now shifting from diagnostic evaluation to prognostics and therapeutic planning. This principle was first realized in aphasiology as the "psychosocial" approach to rehabilitation, which involves studying the social relationships between the patient and other members of the therapeutic group (Tsvetkova et al. 1979, 1985), as well as studies of interrelations between communication disorders and personality in different nosological groups (Glozman 2004). This approach gave rise in contemporary neuropsychology to behavioral neuropsychology, the neuropsychology of everyday life, the neuropsychology of family, and the neuropsychology of personality. The last is an area of special concern to me. "The optimal organization of communication within the therapeutic group provides the conditions for the mobilization of creative activity in the patient's mental sphere and personality, and aids the growth of one's self-perception and 'mental development'… *The internal (the subject) acts through the external, and in so doing changes itself*" (Glozman 2004:148-149).

This new phase in the development of neuropsychology resulted in a revision of the principles of neuropsychological assessment and rehabilitation. One should bear in mind that the Lurian approach to neuropsychological assessment means not limiting oneself to the simple statement that one or another form of mental activity is affected. The assessment must be a "*qualitative (structural) analysis* of the symptom under study, specifying the observed defect and the factors causing it" (Luria 1969:306). Such an approach finds its expression in modern psychology in the differentiation of the *product* and *process* dimensions of performance (Roy et al. 2004). The product dimension reflects the level of performance on a task (accuracy, time, number of mistakes and so on) with reference to some expected (normative) level of performance. This is a typical approach in psychometric neuropsychological assessment. The process dimension refers to the means by which the performer achieves the product or the level of help or stimulation needed to achieve it. Luria considered the process dimension to be the most important to determine primary or secondary disturbances and the zone of proximal development of the assessed subject. Neuropsychological assessment should emphasize the subject's strengths, which are important in her/his rehabilitation program and predict ultimate integration into society.

The next task is to evaluate the effectiveness of rehabilitation. As already stated, Luria's approach presupposes a qualitative analysis of the symptom under study, based upon an understanding of the factors underlying complex psychological activities. The quantitative evaluation of disturbances is of primary value for determining the dynamics of change in cognitive functioning during neuropsychological follow-up, and for measuring the outcome of rehabilitative or remedial procedures. We have proposed a generalized system of rating used Luria's assessment method, that is, a double system of patient performance evaluation: the first step is to make a list of possible defects in fulfilling each task (qualitative evaluation). The examiner marks a plus or minus for each item in the list for every patient. This results in:

- a neuropsychological pattern of cognitive disorders for the examined patient;
- a typical neuropsychological pattern of cognitive disorders for the studied group of patients;
- the dynamics of the patterns observed after treatment, that is, the disappearance of some symptoms (positive dynamics) or the appearance of new ones (negative dynamics).

The second step is to evaluate quantitatively the magnitude of each symptom and the severity of disturbances (a quantitative expression of the pattern of disturbances and of the level of the patient's performance), using a 6-point scoring system that takes account of normative (reference) values, of the qualification of the symptoms (primary or secondary defects), the conditions for correcting errors, and patient's capability to achieve successful task fulfillment with or without external assistance (Glozman 1999b).

CURRENT APPROACHES TO NEUROPSYCHYOLOGICAL REHABILITATION

Quality of Life

Let me pass now to contemporary changes in neuropsychological rehabilitation. First, we should mention *the patient-centered approaches in neuropsychological rehabilitation*, that is, those whose primary focus is on the experience of individuals, their subjective interpretation and personal knowledge of health and disease, their coping strategies, self-esteem, emotional well-being and social interaction. The person-centered approach has long been thought to lack scientific rigor, but it is now becoming more and more recognized. It enables us to explain why persons who have apparently incurred the same damages, even if they use similar coping mechanisms and have equivalent social support, show different degrees of stress and depression, as well as different outcomes after rehabilitation.

As Anna-Lise Christensen has written: "The tragedy of brain damaged victims is more curtailments or loss of life transactions, than a loss of physical skills" (Christensen & Uzzell, 1987:XV). The problem of **Quality of Life** is related to the most crucial psychological topics, such as self-perception, family relations, stress effects and coping strategies, the interface of mental and physical health, and so on. Quality of Life is a new and a very important concept in disability evaluation. It can be considered as *an outcome measure* for health care and rehabilitation, or as *a health status and a sign* of functional disability, disease progression or regression, or a *manifestation of social circumstance and external conditions*, as well as a s*ubjective internal construct of self-evaluation* and *psychological well-being* not corresponding closely to external conditions (Glozman 1991, 2004b; Murell 1999; Phillips 1993). In other words: *is Quality of Life a subjective or objective construct*? It is obvious that Quality of Life is a multidimensional phenomenon that requires an integrated approach to conceptualization, but is Quality of Life mostly determined by the severity of the disease and the effectiveness of rehabilitation, or by the personality of the subject?

From the patient-centered view, **Quality of Life** means the perception and evaluation by the patient themselves of the impact that the disease and its consequences have produced in their lives. The optimal Quality of Life is the patients' *self-satisfaction* with the mental and physical features of their own life and the results of the rehabilitation program. Thus the quality of life is *not the absolute degree* of preserved or restored ability (the "quantities" of life), but its *relative preservation* as compared with a premorbid level of ability.

Emotional and social factors, familial and recreational functioning are closely associated with one's Quality of Life. For instance, the ability to help others or to make meaningful contributions to family have been viewed by interview subjects as essential to maintaining the quality of their lives (Phillips 1993). A special survey has also proved that family-related activities are as important for the subject as professional activities (Glozman 1991).

The role of the family

Another important aspect of contemporary neuropsychology is the *neuropsychology of family*, that is, the social consequences of brain damage on the quality of life of caregivers. It is well known that a chronically disabled person may often disorganize the life of the entire family, change the family's overall lifestyle, and *disrupt the established balance within the family*. The loss of the ability to work and the resulting disability changes the entire social and work status of the patient. S/he loses relationships which had been previously formed and which to a large extent specified and determined his or her reactions to disease. The number of relationships decreases considerably, and this inevitably results in an increase in the importance of family relationships. Thus *the microenvironment now becomes the macroenvironment*. This change leads to the reassignment of the functional roles of family members, which inevitably influences the nature of interpersonal perception among the family members.

Although families are the most valuable and the most vulnerable resource for the disabled patient, and the family members play a major role in supporting their impaired relative, the *emphasis in research has been primarily on the person with the disease and the disease process rather than on family caregivers*.

Being an important factor which determines to a large extent the patient's personality, the nature of interpersonal relations and interpersonal perceptions in the family may either contribute to or interfere with the activation of residual or restored abilities. Negative attitudes on the part of family members, such as unrealistic expectations, feelings of guilt, hyperprotection, excessive attention or social alienation – including cases of total estrangement, hypercritical or hyperanxious attitudes, etc. – can cause a decrease in the patient's cognitive and motor abilities, and can also lead to greater disability and more pronounced emotional disorders.

Patients in the advanced stages of disease become dependent upon family members and require permanent help from their caregivers, resulting in an increasing loss of various aspects of their former professional and social lives, abilities to conduct their own affairs and care for themselves, particularly if the caregivers are old and frail themselves. This pertains in particular to the parents of young persons with degenerative diseases that have a progressive course, as for example in the MELAS syndrome. Slowly progressive dementia, episodic aphasia with residual effects, cortical blindness and/or deafness and other symptoms, often baffling and frightening for the care-

Table 1. Aspects of family burden

ECONOMIC STATUS	PHYSICAL HEALTH	PSYCHOLOGICAL FUNCTIONING	SOCIAL WELL-BEING
• decreased professional activity • loss of earnings • expenses of treatment	• depression and stress • fatigue and strain • need for medications and medical help	• job-caregiving conflict • constriction of social contacts • rare holidays • rare outings	• changing family roles • affectional deprivation and emotional donation • decreased ability to help other relatives • family conflict

givers, who must deal with the uncertain diagnosis and a grim prognosis, and watch as the young patient seems to turn very old very fast – all this makes the burden of care nearly intolerable (Pachalska & MacQueen 2001).

It is important that caregiving is not at all a transitory event that comes and goes: it is a situation exerting permanent, day-to-day pressure, and transforming the caregiver's life and self-image. It may limit the caregivers' abilities to provide help to their impaired relative as fully and as long as they would like, and threatens the caregivers' physical and emotional well-being. Caregiver distress may also result from witnessing the decline and anticipating the death of a loved one.

Table 1 shows the factors that tend to increase the family burden (Glozman, 2004b).

Caregiving is therefore representative of many situations out of which chronic stress can develop. Caregivers are at high risk for diminished quality of life because of the time and energy involved in providing needed care. Many caregivers give up employment or reduce their work schedule to carry out caregiving tasks. It is important that, even in cases when patients are well-controlled on medication so as to make few if any physical demands, the caregivers may experience emotional stress related to:

- the emotional support needed by the patient;
- deprivation of affection exchange;
- inability to share enjoyable activities, plans, household problems;
- feeling of being coerced into caregiving activities;
- uncertainty about prognosis and availability of support.

Emotional support, that is, maintaining social interaction and cheering up the patient, is one of the most universal caregiving tasks, demanding "emotional donation" from the caregiver. Emotional donation is an emotional surcharge by the caregiver dangerous for his/her own mental health and emotional well-being. It is often experienced as a greater burden than that caused by the physical aspects of care, and can radiate out to areas of life other than caregiving itself.

It is possible to identify three main groups of possible determinants of decreased Quality of Life in caregivers (see Table 2).

For instance, older caregivers are more susceptible to overload than younger, but the younger suffer more from the sense of isolation and alien-

Table. 2. Factors related to decrease in quality of life of caregivers

CLINICAL FACTORS	PSYCHOLOGICAL FACTORS	SOCIO-DEMOGRAPHIC FACTORS
Disease form	Family relationship	Age of patient and caregiver
Disease stage	Coping strategies	Educational level
Disease duration	Perception of support availability	Financial status
Cognitive and behavioral disorders	Duration of bond	Family position of caregiver

• • •

ation from the larger social world as a result of the curtailment of social and leisure activities; female caregivers are significantly more distressed than male caregivers. Nonetheless, male caregivers show a significant increase in depressive symptoms over time

We have developed a comprehensive but not time-consuming questionnaire covering the caregivers' activities from various different perspectives: professional, family-related, social, and others (Glozman 2004b). Our results revealed that 100% of the assessed caregivers of patients with Parkinson's disease manifested some features of decreased quality of life, such as:

- reduced or no ability to handle the responsibilities of employment;
- loss of outings and holidays;
- problems with household management;
- the feeling of a permanent lack of time;
- difficulties in attending to the needs of their children or relatives as well as before, sometimes with negative consequences on the children's school activities.

There were also symptoms of a disturbed balance in family relationships: from 21 to 100% of the caregivers, predominantly wives, complained that they now seldom discussed family plans and problems with their relatives and have to decide everything by themselves, while before the disease the husband was the head of the family and the primary decision-maker.

One significant factor in the Quality of Life of caregivers was the duration of a chronic disease, such as PD, because of the progressively debilitating course of the disease After 5 years of caregiving, the risk of severely disordered adaptation increased by more than 3 times in comparison with the group of caregivers of patients with a shorter duration of PD.

With regard to cognitive disorders, our data suggest that Quality of Life is not related to the global scores describing the patients' cognitive disorders, but to specific problems, such as disordered thinking, emotional instability, exhaustibility, loss of criticism regarding one's own symptoms, and disorders of orientation in time and situation.

Our longitudinal study of some patients and their caregivers showed that if the neurological and neuropsychological state of patients improved after treatment, the scores in our Caregivers Quality of Life Scale also increased.

Thus the home should be recognized as a center of care and *the patient-caregiver dyad should be viewed as an unit* when detecting problematic situations and targeting appropriate and efficient neuropsychological interventions by professional practitioners, because patients and caregivers reciprocally affect each other and the practitioner. These interventions must be adjusted constantly as functional changes occur, and they should be incorporated as much as possible into family lifestyles.

CONCLUSIONS

To conclude: three main trends characterize the development of neuropsychology as we enter a new century:

1. Extensive further expansion of research and practice, embracing numerous new domains and nosological patient groups;
2. Combination of qualitative and quantitative approaches;
3. Social and personality-based orientation.

This proves that Luria's work has had a significant global influence on psychological theory and practice, not only in neuropsychology, but also in other branches of social and human sciences. "Indeed, some of Luria's original contributions have become integral components of thought in this area, and have appeared frequently in the writings of others – who often fail to realize their origin" (Geschwind 1972), because Luria's approach is a scientific phenomenon the value of which cannot be limited to the accomplishments of the author himself. Rather, the legacy of Alexander Romanovich Luria opens potentials of development in new branches and orientations.

REFERENCES

Akhutina TV (1998) Neuropsychology of individual differences in children as a basis for the application of neuropsychological methods at school. In: Homskaya ED, Akhutina TV (eds.), First International Luria Memorial Conference Proceedings. Moscow: Russian Psychological Association Press: 201-208. In Russian.

Akhutina TV (2004) Writing: Assessment and remediation. In: Akhutina TV, Glozman JM, Moskovich LI, Robbins D (eds.), A.R. Luria and contemporary psychology: Festschrift celebrating the centennial of the birth of Luria. New York: Nova Science. pp. 125-145

Akhutina TV, Glozman JM (1995) The neurolinguistic study of semantics. Aphasiology, 9(2), 143-152

Bloom J, Hynd G (2005) The role of corpus callosum in interhemispheric transfer of information: Excitation or inhibition? Neuropsychology Review, 2, 59-73

Christensen A-L, Uzzell B, eds. (1987) Neuropsychological rehabilitation. Boston: Kluwer Academic Press

Fioravanti M, Carlone O, Vitale B, Cinti M, Clare L (2005) A meta-analysis of cognitive deficits in adults with a diagnosis of schizophrenia. Neuropsychology Review, 2, 73-97

Glozman JM (1991) Social rehabilitation in brain damaged patients. In: Forchhammer H (ed.), Luria lectures: Soviet contributions of 1990. Copenhagen: Hans Reitzels Forlag. pp. 42-62

Glozman JM (1999a) Russian neuropsychology after Luria. Neuropsychology Review, 1, 33-44

Glozman JM (1999b) The quantitative evaluation of neuropsychological assessment data. Moscow: Center of Special Education Press. In Russian

Glozman JM (2004a) Communication disorders and personality. New York: Kluwer Academic

Glozman JM (2004b) Quality of life of caregivers. Neuropsychology Review, 14(4), 183-196

Glozman JM, Levin OS, Tupper D (2004) Executive behavior after cortical and subcortical brain damage. In: Akhutina TV, Glozman JM, Moskovich LI, Robbins D (eds.), A.R. Luria and contemporary psychology: Festschrift celebrating the centennial of the birth of Luria. New York: Nova Science. pp. 65-77

Gorina IS, Kosterina MY (1996) Study of neuropsychological deficits in subjects participating in Chernobyl catastrophe consequences elimination. Psychology Today, 2/4, 57-64. In Russian.

Homskaya ED, Batova NY (1998) Brain and emotions. Moscow: Russian Pedagogical Agency Press. In Russian.

Homskaya ED, Efimova IV, Budyka EV, Enikolopova EV (1997) Neuropsychology of individual differences. Moscow: Russian Pedagogical Agency Press. In Russian.

Kalita NG (1976) On nature and mechanisms of naming disturbances in acoustico-mnestic aphasia. Dissertation Moscow. In Russian.

Korsakova NK (1998) Neuropsychogerontology: Development of A.R. Luria's school of ideas. In: Homskaya ED, Akhutina TV (eds.), First International Luria Memorial Conference Proceedings. Moscow: Russian Psychological Association Press. pp. 249-254. In Russian.

Korsakova NK (2005) The multi-determined nature of neuropsychological symptoms in patients with mental and somatic disorders. In: Akhutina TV, Glozman JM, Moskovich LI, Robbins D (eds.), A.R. Luria and contemporary psychology: Festschrift celebrating the centennial of the birth of Luria. New York: Nova Science. pp. 77-82

Korsakova NK, Mikadze YV (1982) Neuropsychological studies of memory: results and perspectives. In: Homskaya ED, Tsvetkova LS, Zeigarnik BV (eds.), A.R. Luria and modern psychology. Moscow: Moscow University Press:101-110. In Russian.

Korsakova NK, Moskovichyute LI (1985) Subcortical structures and mental processes. Moscow: Moscow University Press. In Russian

Luria AR (1973) The working brain. An introduction to neuropsychology. London: Penguin Books

Luria AR (1976a) The neuropsychology of memory. Washington: Winston

Luria AR (1976b) Basic problems of neurolinguistics. The Hague: Mouton

Meerson YA, Dobrovolskaya NV (1998) Disorders in perception of absolute and relative objects localization in spatial depth (depth agnosia) after focal damage of the right or left cerebral hemisphere. In: Homskaya ED, Akhutina TV (eds.), First International Luria Memorial Conference Proceedings. Moscow: Russian Psychological Association Press. pp. 87-94. In Russian

Mikadze YV, Korsakova NK (1994) Neuropsychological diagnosis and correction of primary school children. Moscow: Inteltex. In Russian

Moskovich LI (2004) Cerebral hemisphere asymmetry on the cortical and subcortical levels. In: Akhutina TV, Glozman JM, Moskovich LI, Robbins D (eds.), A.R. Luria and contemporary psychology: Festschrift celebrating the centennial of the birth of Luria. New York: Nova Science. pp. 11-13

Murrell R (1999) Quality of Life and neurological illness: a review of the literature. Neuropsychology Review, 9(4), 209-230

Pachalska M, MacQueen BD (2001) Episodic aphasia with residual effects in a patient with progressive dementia resulting from a mitochondrial cytopathy (MELAS). Aphasiology, 15(6), 599-615

Phillips LR (1993) The role of nursing in care of the elderly. In: Lieberman F, Collen M (eds.), Aging in good health. A Quality of Lifestyle for the later years. New York – London: Plenum Press. pp. 115-129

Polyakov VM (2004) Neuropsychological screening of child population. In: Akhutina TV, Glozman JM, Moskovich LI, Robbins D (eds.), A.R. Luria and contemporary psychology: Festschrift celebrating the centennial of the birth of Luria. New York: Nova Science. pp. 93-105

Postnov VG, Korsakova NG, Litasova EE, Lomivorotov VN (1999) Morphofunctional mechanisms of mental disorders in patients after heart surgery with long-term assisted blood circulation. Pathology of Blood Circulation and Heart Surgery, 1, 59-63. In Russian..

Roy EA, Bottos S, Pryde K, Dewey D (2004) Approaches to understanding the neurobehavioral mechanisms associated with motor impairments in children. In: Dewey D, Tupper D (eds.), Developmental motor disorders. A neuropsychological perspective. New York: Guilford Press

Simernitskaya EG (1978) Hemispheric dominance. Moscow: Moscow University Press. In Russian

Schutz L (2005) Broad-perspective perceptive disorder of the right hemisphere. Neuropsychology Review, 15, 1-11

Tsvetkova LS (1985) Neuropsychological rehabilitation of patients. Moscow: Moscow University Press. In Russian

Tsvetkova LS, Glozman JM, Kalita NG, Maximenko MY,, Tsyganok AA (1979) Socio-psychological aspect of aphasics rehabilitation. Moscow: Moscow University Press. In Russian

Tupper DE, Cicerone KD (1990) Introduction to the neuropsychology of everyday life. In: Tupper D, Cicerone K (eds), The neuropsychology of everyday life: assessment and basic competences. Boston: Kluwer Academic Publishers. pp. 3-18

Vartanov AV, Glozman JM, Kisselnikov AA, Karpova NL (2005) Cerebral organization of verbal action in stutterers. Human Physiology, 31(2), 132-136

Vasserman LI, Lassan LP (1989) Effect of lateralization of subcortical stereotaxic destruction on post surgery dynamics of mental functions in subjects with epilepsy. In: Clinical aspects of the problem of brain functional asymmetry. Minsk, Belarus. In Russian.

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