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Editorial

This special issue of "Psychology in Russia: State of the Art" is dedicated to the 120th anniversary of Lev Vygotsky, an outstanding Russian (Soviet) psychologist whose cultural-historical approach has given rise to numerous theoretical advances, empirical research and applied methods in psychology and education worldwide.

Though a journal issue cannot comprehensively and comprehensively describe Vygostky's legacy, we hope to outline some important trajectories of its development. Such attempt is successfully made by Alfredo Ardila in the article "L.S. Vygotsky in the 21st century" in the "Theory and methodology" section. Joaquim Quintino-Aires claims the opposite: "the crisis in psychology" continues and it is the time to begin dialog, not to summarize it.

In the "Neuropsychology" section Janna M. Glozman outlines historical aspects of Vygotsky's contribution to applied neuropsychology. Aleksandr M. Chernorizov, Sergei A. Isaychev, and Yury P. Zinchenko with the colleagues review new approaches and perspectives in psychophysiological methods for the diagnostics of human functional states. Cultural-historical approach to neuropsychological studies is represented by the paper on psychophysiological, developmental, and cross-cultural aspects of face cognition by Aleksandr M. Chernorizov, Zhong-qing Jiang, Anastasia V. Petrakova, and Yury P. Zinchenko. Neurophysiological correlates of artistic image creation by representatives of artistic professions are revealed by Liudmila A. Dikaya, Igor S. Dikiy, Viktorija V. Karpova, and Anastasiya Y. Lavreshina. Finally, Arnoldo Téllez and Teresa de J. Sánchez propose the model of the functional units of the brain and the concept of neuropsychology of dreaming, based on the works by Aleksandr Luria, an outstanding neuropsychologist and Vygotsky's collaborator.

In the "Educational psychology" section two articles deal with psychological assessment techniques. Larisa F. Bayanova, Ekaterina A. Tsivilskaya, Roksana M. Bayramyan, and Kirill S. Chulyukin describe pilot results of application of a cultural congruence test for primary school students. Yulia Solovieva and Luis Quintanar apply the concept of *zone of proximal development* to assessment of intellectual development in pre-school children. The paper by Vladimir S. Sobkin, Aleksandr N. Veraksa, Darya A. Bukhalenkova with the colleagues dwells on the concept of

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social situation of development and analyses the connection of socio-demographic factors and child-parent relationships to the psychological aspects of children's development.

In the "Clinical psychology" section the ideas by Lev Vygotsky and Aleksandr Luria are applied to psychological support and development of various populations of children. Lidia F. Fatikhova and Elena F. Sayfutdiyarova have investigated understanding of unsafe situations by children with intellectual disabilities. Héctor Juan Pelayo González, Yulia Solovieva and Luis Quintanar with the colleagues propose interventions for psychomotor development in newborns with low weight according to A.R. Luria's conception. Pedro Ferreira Alves, Tâmara Ferreira Rodrigues, Claudia Tirone, and Diego Prade describe Rita Leal School model: a new, cultural-historical perspective on autism. To study personality attributes of children with behavior problems Ana Beatriz Saraiva and Jorge Ferreira have performed an exploratory analysis with the Exner Comprehensive System of the Rorschach Inkblot Test and suggested some implications for the socio-historical clinical practice approach. The section is summarized by a methodological article by Aleksandr Sh.Tkhostov that outlines the prospects of development of L.S. Vygotsky's ideas in clinical psychology.

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THEORY AND METHODOLOGY

L.S. Vygotsky in the 21st century

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Although Lev Vygotsky's interpretation of human cognition was proposed almost one century ago, new scientific and technological advances have significantly supported many of his ideas and hypotheses. His cultural-historical theory of psychological processes, and his contributions to educational psychology, have continued growing without interruption. In this paper, three of Vygotsky's hypotheses are examined in light of 21st century scientific developments:

1) The influence of cultural factors on human cognition. A diversity of research studies in different countries has corroborated the crucial impact of culture on cognitive test performance;

2) The role of language in higher psychological processes. According to Vygotsky's cultural-historical approach, cognitive processes ("complex psychological processes") are social in origin, but complex and hierarchical in their structure. Intrinsic to the systemic organization of higher cognitive processes is the engagement of external artifacts (objects, symbols, signs), which have an independent history of development within a culture; and

3) The hypothesis that thought and general complex cognition is associated with certain "inner speech." Some contemporary neuroimaging studies (particularly PET and fMRI) analyzing "inner speech" have been carried out. These studies have attempted to find the areas of the brain involved in "inner speech." These scientific advances significantly support Vygotsky's interpretation of human cognition. It has been found that inner speech depends on activity in Broca's area and related brain network activity in the left hemisphere. Hence, inner speech is closely related to grammar, language production, and executive functions.

Vygotsky's important contribution to the understanding of psychological processes has stimulated, and continues to stimulate, a substantial amount of research in this area.

Keywords: Vygotsky, cultural-historical psychology, literacy, inner speech, cognition

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Introduction

Lev Semyonovich Vygotsky is one of the major and most influential authors in psychology and pedagogy in recent history (Haggbloom et al., 2002). Despite his short life (1896-1934), his ideas have solidified, remained, and flourished. Plenty of papers, book chapters, and books analyzing, discussing, and advancing his ideas (Bybee, 2015; Saxe, 2015) continue to be published worldwide.

Despite the fact that Vygotsky's interpretation of human cognition was proposed almost one century ago (Vygotsky, 1929, 1934/1968, 1934/2012; Vygotsky & Wollock, 1997), new scientific and technological advances have significantly supported many of his ideas and hypotheses. His cultural-historical theory of psychological processes, and his contributions to educational psychology, have continued growing without interruption *(Gredler, 2012;* Roth & Lee, 2007; *Wertsch, 1985;* Yasnitsky, van der Veer & Ferrari, 2014; Yasnitsky & van der Veer, 2015).

In this paper, three of Vygotsky's hypotheses will be examined at the light of 21st century scientific developments: 1) The influence of cultural factors on human cognition — that is, his cultural-historical approach to psychology; 2) The role of language in higher psychological processes (i.e., language represents the major mediator of human cognition); and finally, 3) The hypothesis that thought and general complex cognition ("complex psychological processes," according to Vygotsky) are associated with certain "inner speech." At the conclusion of this paper, some general conclusions will be presented.

The influence of cultural factors on human cognition

One of the major research questions Vygotsky tackled was pinpointing the impact of cultural factors on human cognition. To approach this question, he and A.R. Luria planned two expeditions to Uzbekistan during 1930 and 1931, although only Luria actually travelled there, with some other colleagues. The purpose of this research program was clear: to investigate the influence of culture, and in particular, one of its most important institutions, education, on the development of higher cognitive functions (Luria, 1931, 1933, 1976a).

This research program resulted in several papers, the conclusions of which were controversial. One of the major conclusions was that illiterate people are bound to the concrete situations of real life; Consequently, they have difficulties solving problems that are beyond their personal experience. The obvious conclusion was that the use of abstract reasoning is to a significant degree dependent upon schooling.

This major conclusion is congruent with contemporary research in the area. For instance, Gómez-Pérez and Ostrosky-Solís (2006) studied 521 normal individuals, aged 6 to 85 years. Their educational level ranged from 0 to 22 years. Several memory and executive function tests were administered to each individual. It was found that factors related to memory are sensitive to age, whereas those related to executive functions (that is, "complex psychological processes") are significantly sensitive to education. Unquestionably, abstracting, problem solving, and similar abilities are associated with the individual's level of education, as Luria and Vygotsky's study in Uzbekistan during the 1930s concluded.

A diversity of research studies carried out in different countries has corroborated the crucial impact of culture on cognitive test performance (For a review, see Ardila, 2013; Ardila & Keating, 2013). To exemplify this point, three specific questions will be analyzed in this section: a) Cognitive test performance in Amerindian populations, as an example of cognition in non-Western societies; b) The impact of culture on non-verbal abilities; this is in order to emphasize that the effect of culture on cognition is not limited to verbal abilities; 3) The influence of education on cognition. It has been pointed out that schooling can be regarded as a sub-culture itself, which includes certain specific values (e.g., learning is important) as well as an interpretation of the world (a worldview or *Weltanschauung* — frequently but not necessarily, a scientific interpretation of the world).

Cognitive test performance in Amerindian populations

Very few studies have analyzed the performance of Amerindian individuals' cognitive abilities. Pontius (1989) studied 19 healthy adult populations of nomadic Auca Indians of the Ecuadorian Amazon basin, who had never been missionized. The following tests were administered: the four-colored Kohs Block Design, and others measuring spatial-relational, lexical, and body and face shape recognition. The test results revealed a specific group of deficiencies, namely those in: color naming (with preservation of color concept); block design — especially related to representation, and construction of certain intra-pattern spatial relations; and graphic representational skills. The author suggests that these deficiencies have similarities to certain neuropsychological syndromes observed in cases of brain dysfunction.

Ostrosky-Solís, Ramirez and Ardila (2004) analyzed the influence of education and culture on the neuropsychological profile of an indigenous and a nonindigenous population in Mexico. The sample included 27 individuals divided into four groups: a) seven illiterate Mayan indigenous participants; b) six illiterate Pame indigenous participants; c) seven nonindigenous participants with no education; and d) seven Mayan indigenous participants with 1 to 4 years of education. A brief neuropsychological test battery developed and standardized in Mexico was administered to each individual. Results demonstrated differential effects for both variables (cultural group and education). Both groups of indigenous participants (Mayan and Pame) obtained higher scores in visuospatial tasks, while their level of education had significant effects on working and verbal memory tests. No significant differences were found in other cognitive processes (orientation, comprehension, and some executive functions). The authors suggested that both variables (culture and education) affect performance in different neuropsychological tests, but their effect differs depending upon the specific test.

Ardila and Moreno (2001) selected a sample of 20 right-handed Aruaco Indians (12 male, 8 female; age 8–30 years) from the Sierra Nevada de Santa Marta (Colombia). A brief neuropsychological test battery was individually administered. The battery included tests evaluating: visuoconstructive and visuoperceptual abilities, memory, ideomotor praxis, verbal fluency, spatial abilities, and concept formation. In some neuropsychological tests, performance was virtually perfect (Recognition of Overlapped Figures and Ideomotor Praxis Ability test), whereas in other

tests it was non-existent (e.g., Block Design using a time limit). It was proposed that two types of variables were significantly affecting performance: 1) educational level; and 2) cultural relevance. Some tests appeared significant and meaningful (for example, recognition of overlapped figures) to the participants, whereas others were meaningless and even impossible to understand (e.g., drawing a map).

Everett (2005) analyzed some cultural idiosyncrasies associated with the specific and unusual characteristics of the Pirah language spoken by Pirahã people, an indigenous hunter-gatherer group of the Amazon Rainforest in Brazil. Pirah culture constrains communication to non-abstract subjects, which fall within the immediate experience of the interlocutors. This constraint results in some surprising features of Pirah grammar and culture: the absence of numbers of any kind, or a concept of counting or of any terms for quantification; the absence of terms for different colors, evident when one color is embedded in another; the simplest pronoun inventory known; the absence of relative tenses; the simplest kinship system yet documented; the absence of creating myths or fictional stories; and the absence of any individual or collective memory for more than two generations past; the absence of drawing or other art. This is one of the simplest material cultures ever documented. Furthermore, it is surprising that the Pirah are monolingual after more than 200 years of regular contact with Brazilians and other Indian groups. The author argues that these very unusual characteristics of the Pirah language's perspective, ultimately derive from a single cultural constraint in Pirah culture: namely, *restricting communication to the immediate experience of the interlocutors*. This conclusion clearly suggests that certain cultural practices may significantly affect the idiosyncrasies of spoken language.

Today there is no doubt that culture has a significant impact on the pattern of cognitive abilities, as proposed by Vygotsky and demonstrated not only in Amerindian cultures, but also in a diversity of cultural groups around the world (see: Laboratory of Comparative Human Cognition, 1983). As a matter of fact, a new area of neuropsychology has been developed during recent decades, specifically devoted to the analysis of the effect of culture on cognition; this area is usually known as "cross-cultural neuropsychology" (Fletcher-Janzen, Strickland & Reynolds, 2000; Uzzel, Ponton & Ardila, 2013).

The impact of culture on non-verbal abilities

During the Uzbekistan expeditions, Luria and Vygotsky observed that the Uzbeks' perceptual and spatial abilities were quite different than in Western people (Luria, 1976a, 1979), and hence, nonverbal abilities were significantly affected by cultural conditions. For instance, Uzbek people living in non-urban environments are much less prone to visual illusions, such as the Müller-Lyer illusion, than people living in typical Western environments. The famous telegram sent to Vygotsky by Luria from his travel to Middle Asia read: "Uzbeks do not have illusions." This important observation has been confirmed in diverse studies: Culture significantly affects perceptual and spatial abilities.

Regardless of contrary evidence, the idea that non-verbal cognitive tests can be culturally free is frequently found in psychological literature. As a matter of fact, there are diverse intellectual tests that are assumed to be "culture-free," or "culture-

fair," simply because they include mostly nonverbal items (e.g., Alexander, 1987; Crampton & Jerabek, 2000). This assumption contradicts the evidence of contemporary anthropology and cross-cultural psychology (e.g., Berry, Poortinga, & Segall, 1992; Harris, 1983; Irvine & Berry, 1988; Saxe, 2015; Wilson, 2010).

Culture can significantly affect the development of non-verbal skills (for a review, see Rosselli & Ardila, 2003). Furthermore, ecological conditions and cultural practices are significantly associated with the development of perceptual, spatial, and constructional skills (Cole & Means, 1986). Cross-cultural differences in perceptual and constructional abilities have been extensively studied and analyzed in anthropology and cross-cultural psychology (e.g., Berry, 1971, 1979; Gay & Cole, 1967; Hudson, 1962; Laboratory of Comparative Human Cognition, 1983; Segall, 1986; Smith, Fischer, Vignoles & Bond, 2013). Furthermore, certain non-verbal abilities that are frequently taken for granted, such as drawing a map and copying figures, as measured by current cognitive tests, are not universal skills. They can be meaningless to members of some cultures, such as the Colombian Aruaco Indians (Ardila & Moreno, 2001).

Non-verbal tests currently used in psychology and neuropsychology are not necessarily more appropriate for cross-cultural testing than verbal tests. As mentioned above, Ardila and Moreno (2001) found that the Aruaco Indians' performance was particularly low when they were asked to copy the Rey-Osterrieth Complex Figure (a typical constructional ability test in neuropsychology), and to take a Draw-a-Map test (a spatial orientation test), whereas their verbal fluency test performance was within the normal range. Conversely, Mulenga et al. (2001) found that Zambian children performed better in visuospatial tests (such as design copying) than U.S. children. Indeed, visuoconstructive and visuospatial test scores may be lower or higher in diverse cultural groups, but the important point is that they differ due to cultural factors.

School as a sub-culture: The impact of education

As mentioned above, one of the major conclusions of the Uzbekistan expedition was that illiterate people are bound to concrete real life situations; consequently, they have difficulties solving problems that are beyond their personal experience (Luria, 1931, 1933, 1976a). This conclusion has been extensively supported by a myriad of studies carried out in different countries (see: Scribner, Cole & Cole, 1981; Ardila et al., 2010).

Literacy (i.e., extending spoken language to a symbolic visual representation) plays a major role in mediating cognitive processes. Luria (1931, 1933, 1976a) and Vygotsky (1934/1978) developed the concept of extra-cortical "organization of higher mental functions" to account for the interaction of biological and cultural factors in the development of human cognition (Kotik-Friedgut & Ardila, 2004). Luria (1973) explained that "*It is this principle of construction of functional systems of the human brain that Vygotsky called the principle of 'extra-cortical organization of complex mental functions,' implying by this somewhat unusual term that all types of human conscious activity are always formed with support of external auxiliary tools or aids.*" (page 31) Written language represents a major support for extending oral language, in particular, and human cognition in general.

Evidently, without written language, our knowledge of the external world is partially limited by immediate sensory information and concrete environmental conditions. Thus, Reis, Guerreiro and Petersson (2003) found that if in a verbal fluency task (to name objects corresponding to a specific semantic category, for instance, animals, fruits, clothes, etc.), the participants are asked "to name as many different things as possible that one can buy at the supermarket in 1 minute" (a quite concrete context), no educational effect is found, and performance in literate and illiterate participants is similar. However, significant differences between literate and illiterate subjects are found when using a more abstract category (e.g., to name animals); this is because literate people usually know the names of many animals that they have never seen — for example, penguins, dinosaurs, etc. — whereas illiterate people can name only those animals they directly know).

Contemporary research has demonstrated that literacy is significantly associated with virtually all cognitive measures, even though the correlation between education and neuropsychological test scores depends on the specific test (Ardila et al., 2010). For instance, the correlation between years of schooling and test scores was found to be 0.62 for Phonological verbal fluency, 0.49 for Semantic verbal fluency, 0.26 for Language repetition, and only 0.07 for Orientation in space (Ostrosky, Ardila & Rosselli, 1999).

Significant differences in performance have been demonstrated, depending upon the educational level, in at least the following domains:

- Motor Functions (e.g., Bramao et al., 2007)
- Calculation and Number Processing (e.g., Deloche et al., 1999)
- Language (e.g., Laboratory of Comparative Human Cognition, 1983).
- Metalinguistic Awareness (e.g., Ventura, Kolinsky, Querido, Fernandes, & Morais, 2007).
- Visuoperceptual and Spatial Abilities (e.g., Ardila, Rosselli, & Rosas, 1989)
- Memory (e.g., Montiel & Matute, 2006)

There is no question but that reading represents an additional instrument to extend human cognition. Contemporary research has corroborated Vygotsky's and Luria's initial suggestions about the significant effect of literacy on human cognition.

The role of language in higher psychological processes

According to Vygotsky's cultural-historical approach (1934/1978), cognitive processes ("complex psychological processes," as he calls them) are social in origin, but complex and hierarchical in their structure. An intrinsic factor in the systemic organization of higher cognitive processes is the engagement of external artifacts (objects, symbols, signs) which have an independent history of development within the culture. According to the concept of "extra-cortical organization of complex mental functions" (Vygotsky, 1929), the role of external factors in establishing functional connections between various brain systems is, in principle, universal. However, different mediators, means, and strategies, or significantly different details within them (e.g. the direction of writing and degree of letter-sound

correspondence, the orientation by maps, etc.) may have been developed and, in fact, continue to develop in different cultures.

At this point, one could ask the following question: How did complex cognition appear in human history? It could be speculated that some crucial inventions fueled the development of cultural evolution and complex cognition (Vygotsky, 1934/1962). The most important candidate for being held responsible for this crucial invention, however, is language. Language allows the transmission of knowledge, and thus increases the probability of survival. Without language, children can only learn from parents by imitation (vicarious learning), but imitation is limited to elementary activities, such as making a simple stone ax. Language represents a major instrument of internal representation of the world and thinking (Vygotsky, 1934/1978). The evolution of language is a slow process that takes thousands of years. But the most critical element of complex human language is the use of grammar, which likely appeared relatively recently in human history (Ardila, 2015; Bickerton, 2007).

The evolution of human language represents one of the most complex questions in contemporary science. Significantly, it has been pointed out that human languages, regardless of the diversity in their details, present profound structural similarities in all regions of the world — i.e. there is core syntax or Universal Grammar (Chomsky, 1965, 1980). This suggests the existence of an original grammar or basic grammar, or at least, some universal principles and strategies used for expressing ideas. These universal principles used to express ideas, which are found in every language world-wide, would result from the specific idiosyncratic organization of the human brain.

Observations of children's language development corroborate that language initially appears as a lexical/semantic system, and only later is a grammatical language found (Hoff, 2013). Grammar is correlated with the ability to represent and use names for actions names (verbs). Furthermore, while lexicon (vocabulary) indicates how the world is conceptualized (words indicate concepts), grammar requires reasoning and thinking strategies.

The hypothesis of "inner speech"

The idea that there is an inner speech — an individual internal language — has a long history. As a matter of fact, at least since Plato (the *Theaetetus* 189e–190a and the *Sophist* 263e), the idea that thinking means using an inner speech has existed; that is, thinking to a significant extent means to talking to ourselves. This idea has been expressed by different authors throughout the modern and contemporary history. This "mental language," as it frequently has been called, differs from ordinary language by consisting solely of meanings, i.e. it signifies without signifiers (Wiley, 2006).

Vygotsky (1934/2012) systematized the concept of inner speech when he referred to three different types of speech: "external speech" (or "social speech" — that is, the speech used in social interactions), "egocentric speech" (or "private speech" — that is, speech to ourselves), and "inner speech" (internalized social speech). It is important to note that there is a process of "internalization" in which the first (external or social speech) is transformed into the second (egocentric

or private speech), and finally into the third (inner speech). As a matter of fact, private speech represents a kind of halfway station between "external" and "inner" speech, but with very distinctive properties. Therefore, Vygotsky's egocentric (private) speech is the link between social (external) speech and organized inner speech. Furthermore, social speech represents the overt, external speech addressed to others (words, sentences) for the purpose of social interaction and communication; whereas inner speech is subvocalized speech directed and adapted to oneself. Private speech, as a midway point between external and inner speech, is vocalized speech addressed and adapted to one's self. Thus, private speech is neither social communication nor silent thought, but rather vocalized thought (Ehrich, 2006; Jones, 2009; Vygotsky (1934/2012).

Following Vygotsky, some have proposed that inner speech has four distinguishing features: a) silence — that is, it is not overtly produced; b) syntactical ellipses or short-cuts (i.e., words may be omitted that are understood in context); c) semantic embeddedness (i.e. highly condensed word meanings); and d) egocentricity or highly personal word meanings (Johnson 1994; Jones, 2009). Vygotsky (1929, 1934/1968, 1934/2012) argued that thought (and so-called "complex psychological processes") is associated with some "inner speech."

In addition, attempts have been made to find the neurological substrate of inner speech. Some contemporary neuroimaging studies (particularly PET and fMRI) analyzing "inner speech" have been carried out. These studies have attempted to find the brain areas involved in "inner speech."

McGuire et al. (1996) analyzed the neural correlates of inner speech and auditory verbal imagery in a sample of normal subjects. Positron Emission Tomography was used to measure brain activity. Single words were presented, and subjects were required to generate short sentences without speaking. Inner speech was associated with increased activity in the left inferior frontal gyrus (Broca's area). Results demonstrated that silent articulation involves increased activity in an area specializing in speech generation — that is, Broca's area (left inferior frontal gyrus).

Geva et al. (2011) studied 17 patients with chronic post-stroke aphasia; participants performed two different types of tasks: a) inner speech tasks (rhyme and homophone judgments), and b) overt speech tasks (reading aloud). The relationship between brain structure and language ability was examined using voxel-based lesion–symptom mapping. It was found that inner speech abilities were affected by lesions in the left *pars opercularis* of the inferior frontal gyrus (Broca's area) and to the white matter adjacent to the left supramarginal gyrus.

Morin and Michaud (2007) analyzed a hypothesis about inner speech's participation in self-referential activity. They reviewed 59 studies measuring brain activity during the processing of self-awareness in several domains relating to the self. The left inferior frontal gyrus (Broca's area) was shown to sustain inner speech use. Moreover, the left inferior frontal gyrus was more frequently recruited into action during conceptual tasks than during perceptual tasks. These results support the view of some degree of involvement of inner speech in self-reflexive processes.

Damage in Broca's area (Brodmann areas 44 and 45, *pars opercularis* and *pars triangularis* of the left inferior frontal gyrus) in the left hemisphere, results in so-called Broca's aphasia. This aphasia is characterized by limitations in, or absence of, grammar, and difficulties in organizing the sequence of articulatory movements

(apraxia of speech), as well as disturbances in executive functions (e.g., Benson & Ardila, 1996; Kertesz, 1979; Luria, 1976b). Considering that this brain area is the crucial area for inner speech, it is easy to conclude that inner speech is associated with grammar and executive functions (complex cognition).

In summary: Inner speech depends on Broca's area activity and related brain network activity in the left hemisphere. *Hence, inner speech is closely related to grammar, language production, and executive functions ("higher psychological processes"). Exactly as proposed by Vygotsky.*

Conclusion

New scientific advances significantly support many of the Vygotsky's ideas about human cognition. It is not surprising that many papers, books, courses, and conferences are devoted to analyzing and discussing Vygotsky's ideas.

Vygotsky represents the origin of (or a specific step in) the development of these ideas and hypotheses, but they are obviously not the final answer. In science, each author makes a particular contribution that will be further developed by other scholars. During the approximately seven decades since Vygotsky's death, diverse studies have extended and frequently re-oriented the original ideas about human cognition presented by Vygotsky. His contribution to understanding psychological processes was enormous, and his ideas have stimulated a significant amount of research in the area.

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Emptiness in psychological science and practice

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Psychology is now one of the most popular sciences for young students. But whether academic production or professional practice, it is still in crisis. When we look together at two different approaches we realize the enormous amount of syncretism. They are not only two different approaches to the same science. They are more than that, they are different areas of knowledge, with very different practical implications. Discussion of psychology with the other sciences researching the same "objects" is nonexistent. So when it comes to practice, many of young psychologists leave the profession.

This article is an invitation to colleagues for a "look inside" this interesting science that can make a significant contribution to human sciences and the better life of human beings in the 21st century. This call is supported by a re-reading of the text by Lev S. Vygotsky *The historical meaning of the crisis in psychology* written in 1927. The article is structured in four subtopics: the problem of general science (in Psychology), the problem of terminology, the problem of difficulty in recognizing the crisis and the problem of emptiness. Being a call, of course, it is not a complete and finished analysis. It is rather a desire that, engaging some colleagues, we can continue the dialogue with Vygotsky on this topic started by him ninety years ago.

Keywords: psychology, crisis, approaches, general science, dialogue, Vygotsky

The stone the builders rejected,
Has become the cornerstone...

This afternoon, after a long period of work, and as in other years after our meetings, many of my exhausted colleagues said: "Oh, it is the same; tomorrow is another long day of work". And I said, as I usually do, "Yeah! Tomorrow is another day of work. Yes!" I reacted in that way because I really like what I do. But I am certain that the reason I really like to do what I do is not just because I am a psychologist, but because someone introduced me to a dialogue with Lev Vygotsky.

I would like to share with you a little bit of my story as a psychologist. In 1991, I had a very good position. At that time it was difficult to get work as a psychologist in Portugal, and even harder if you were a clinical psychologist. Nevertheless, I had

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the opportunity to work as a psychologist at the Laboratory of Neuropsychology of the Department of Neurosurgery at the Lisbon Military Hospital. I must say that I was fortunate to be in this position since this was a very desirable position, available only to the lucky few. Everybody wanted this position. Yet, this was not really what I was looking for.

I remember the day I visited my director and told him about my desire to leave the hospital, because I did not like what I was doing there. He disagreed with me, but I affirmed my view and said: "I do not regret my decision to leave because this job does not give me professional satisfaction." He told me, "Ok, you are very young [he was a military neurosurgeon higher up than me], so go to Barcelona to be trained in Psychology from another perspective. Subsequently, you will decide what to do in your professional life." As a result, after studying historical cultural neuropsychology, the Vygotsky-Luria-Leontev approach, I found my love in Psychology. And each day I am still in dialogue with Vygotsky.

My report is very simple, but it has a strong meaning for me. I will share with you my last reading of a text by Vygotsky, which I have revisited several times. It is "The Historical Meaning of the Crisis in Psychology," written in 1927. I especially want to present some sentences from this book, in hopes of provoking you in the way I was provoked. I have organized the report under four topics: The problem of general science (in Psychology); the problem of terminology; the difficulty in recognizing the crisis; and the problem of emptiness.

The problem of general science

- *"Psychology is pregnant with a general theory, but has not yet given birth."*
- *"A general science is a science that* ***receives material from a variety of particular disciplines,*** *and then prepares and subsequently* ***generalizes them****, a process impossible within each separate discipline."*
- *"Unity is achieved through* ***subordination and dominion****, through the fact that particular disciplines renounce their sovereignty in favor of a general science."*

There is a belief that our branch of science encompasses a great number of professionals, but unfortunately, the only thing many psychologists have in common is sympathy for people. This makes dialogue among different psychologists impossible. Sometimes it is much easier for a psychologist to speak with a biologist than for psychologists to conduct a dialogue among themselves.

- *"When various disciplines have a tendency to develop into a general science and extend their influence to adjacent areas of study, a general science arises from the need to unite heterogeneous branches of knowledge. "*

We must work harder and more courageously in order to produce a General Psychological Science, as Vygotsky invites us to do.

- *"A general science happens to be distinguished from a particular discipline,* ***not because it has a broader scope, a higher content****, but because it is* ***qualitatively*** *differently organized".*

But the problem is that, even if we are specialists in dialogue, in relationships, and in communication — and we can find thousands of psychologists who work only on dialogue, communication, and relationships — we still act like a group of people sitting in a circle, each looking away, i.e., neither looking at nor seeing each other.

I remember a conference on psychotherapy held in 1992 in Lisbon, where the organizing committee had invited all groups represented in Portugal. Each approach — psychoanalytic, cognitive-behavioural, humanistic, etc. — was present. I was absolutely shocked by the fact that they formed separate groups of each discipline. In each room there were only professionals from one approach. No dialogue, only monologue! In my view, we're still taking the same approach.

Of course, we need to learn to work as people in a circle toward the midpoint, watching and listening to others and dialoguing, or creating a General Science will be impossible, unlike what has happened with the other sciences.

> "*But this debate has been impossible. The important thing is to beat the opponent; no one wants to waste time studying it [his point of view]".*

The problem of terminology

The problem of terminology is another serious problem in psychology. For example, if we use the term "cognitive," note the number of different meanings that we'll be using.

- *"If someone wanted to build a clear and objective picture of the* ***situation in psychology today****, ... suffice it to study the psychological language, its nomenclature and terminology, the vocabulary and syntax of the psychologist".*
- *"The highly developed and precise language of modern physics, chemistry, physiology (not to mention math ...) started being formed and perfected at the same time each of these sciences developed, and this did not happen in any way spontaneously, but was produced consciously under the influence of tradition, criticism, and terminological creativity coined by their own* ***societies*** *and* ***scientific congresses****".*

We can illustrate this with the case of the Sociedade Portuguesa de Psicologia, founded in 1960, which has had a scientific journal since 1967, and even been the force behind current laws since 1978. But if we ask a Portuguese psychologist, we will find that a great many professionals (at least 99%) do not know that this society exists. Of course, there are dozens of societies and associations oriented to each of the psychotherapy approaches, and psychologists working in psychotherapy know them, but the Portuguese Psychological Society is practically unknown.

So we still produce, write, and speak unclearly and confusingly, in an ambiguous language, using multi-semantic terms and vague ideas as well. To summarize this issue, we can say that bilingualism persists within psychology, and psychologists do not know different languages, only their own. And to cite the German poet Wolfgang Goethe: "Those who known nothing of foreign languages know nothing of their own".

The difficulty in recognizing the crisis

- *"Science is not a dead entity, finished, immobile, comprised of preset principles..."*
- *"But a living system, constantly evolving and advancing the stated facts, laws, assumptions, structures and conclusions without interruption..."*
- *"Criticized, proven, partially rejected, interpreted, and organized again, etc."*

In my opinion, this is really the more complex issue. It leads us to Bella Kotik's earlier words about Jerome Bruner, who, during a trip to Moscow, started a speech by saying he was very happy to present his ideas to a group which can criticize his work. This is highly clever and honest. But in our current reality, as in the past, Vygotsky observed,

> "*The important thing is to beat the opponent; no one wants to waste time studying it*".

Agreeing with N.N. Lange (1914), Vygotsky emphasizes in this text his idea of the lack of a universally recognized system of science. Each author is a system. In my view, Christians, Evangelicals, Catholics, the Orthodox, and psychologists share a common aspect, which is Narcissism. Each "science" professes its own vanity. And the result is that psychology as a general science does not exist.

Psychology is somewhere between Biology and Sociology, i.e., not a science in itself. And it is amazing that over the last years, maybe the last 20 years, we can testify to this reality becoming stronger and stronger. In fact, there is a lack of psychology in psychology. If we look at the programs for psychology in the universities, we will realize that they are designed closer to Biology or Sociology than to Psychology itself. We have started psychological work, but have not yet established its fundamental principles.

Take the example of behaviorism. Some of the pillars of this branch of psychology were confused about what they really wanted. Are they talking about the same or different paradigms?

J.B. Watson (1878–1950)

– (1913) Psychology as the behaviorist views it. *Psychological Review*, *20*, 158-177.

Clark Leonard Hull (1884–1952)

– (1934) The concept of the habit-family hierarchy and maze learning: Part 1. *Psychological Review*, *41*, 33-54.

Edward Ch. Tolman (1886–1959)

– (1948) Cognitive maps in rats and men. *The Psychological Review, 55(4),* 189-208.

B.F. Skinner (1904–1990)

– (1974) *About Behaviorism*.

A critical look at behaviorism is quickly emerging:

A- The issue of the category of Mind

– "Cognition" as its awkward substitute
– Tolman vs. Hull debate

B- The question of method (experimental introspection)

– Inventories, questionnaires, and other self-assessment tools.

C- The issue of conditioned reflex theory (I. Pavlov) as substance of behaviorism

– Reflex theory is not applicable to the study of human behavior due to the secondary receptor system. Language introduces subjectivity (I. fPavlov, 1924).

D- The issue of the closing of K. Lashley's laboratory in 1959

Several investigations had results contrary to his theory.

In a 1985 work, J.J. White looked at the manuals used in United States universities for the study of cognitive psychology. The seven most used manuals disagree on basic ideas.

- Seven manuals disagree on basic ideas.
- Of 3,246 publications cited, only 19 (0.6%) had basic ideas shared by all.
- Only 146 (4.5%) shared basic concepts in at least three books.
- Few phenomena were included in all the books.
- The same concepts were given different names.

If we go back in time, we will be quite surprised by what was written when psychology was first beginning to be applied to Information Processing Theory.

- (Herbert Simon, 1957) In 10 years psychological theories will be written as computer programs ...;
- (Herbert Simon, 1969) In 20 years, computers will do everything that humans do....

In 2004 a very interesting book was published in Portugal (but it could have been in any other country). The book is *Cognitive Therapies: Theories and Practices*, by Oscar Gonçalves. In the first part of the book, dedicated to theoretical foundations, the author presents a theory of information processing in humans. In the second part, the book is dedicated to the practice of cognitive therapy. Over and over, the theory of information processing and cognitive therapy are both described by the adjective "cognitive"; but the two have nothing to do with one another. At the university where I graduated in psychology, the difference between the two approaches was so great that we felt that many teachers in one department did not relate to teachers from the other. Yet the book was very successful, and no one seemed concerned with the syncretism in it!

The problem of emptiness

In order to get my professorship, I worked on a project for 17 years. My topic was to show the impossibility of an innate organ for language, contrary to what had been proposed by N. Chomsky. Near the end of the project, all of my colleagues told me that my project would excite no interest because scientists had already discovered the gene for language. Since I was not convinced, I went back to university as an undergraduate to study molecular biology and genetics. This was important, because I had the opportunity to learn that the so-famous *FOXP2*, referenced since 2001, was only a transcription factor for the gene CNTNAP2, and that it had nothing specifically to do with language, since it served all complex motor learning both in human and in other species, like birds. Despite this fact, *FOXP2* is referred to as the gene for language by psychologists. And psychologists quickly lost interest in psychological theories of language.

My last work as an undergraduate Molecular Biology and Genetics student naturally focused on *FOXP2*. In all the scientific publications correlating *FOXP2* and language written by biologists, I never found any reference to the extensive literature that exists on the psychology of language, nor psycholinguistics. For biologists, the psychology of language and psycholinguistics did not exist. The only reference that can be considered more or less close to the psychology of language in all of these scientific articles in the 21st century, appeared in one article referencing the A *Treatise of Human Nature* by David Hume from the 18th century. Due to lack of organization, psychology is omitted from the process of constructing knowledge, even on issues such as language.

During the time I was an undergraduate Molecular Biology and Genetics student, I attended molecular biology and genetics conferences. At one of these conferences a report which associated "molecular genetics" and "intellectual disability" caught my attention. The study reported that a different gene sequence alone caused a change in the movement of a nematode, *C. elegans*, by creating malformation of the nervous system. When questioned about the "magic flight" from this study on nematodes to intellectual disability in humans, the authors replied that human intelligence needs the nervous system. This is true, but I think it's just as true that the construction of knowledge about intellectual disability needs psychologists.

One of the hallmarks of a psychologist is the use of tests. Tests need to be adapted for use in new populations. Obviously, this is important work, and it takes thousands of hours of work. So I imagine that when someone starts to adapt a test, first he/she studies what is written about that test. The first neuropsychological battery adapted to the Portuguese population was the Luria-Nebraska Neuropsychological Battery. More than 20 years after the publication of scientific articles criticizing the conceptual construction of this test, it is clear that the attempt to build a theory of psychology occurs without dialogue, in an autistic manner.

This method of building a theory of psychology and working on it, or without it, causes the emptiness that psychologists feel. Today thousands of young people are interested in this beautiful and important science, but not because they imagine they will appreciate studying it. They say they are good counsellors, and friends often seek them out to chat. Talk! Just talk! And the truth is that when they get

to study psychology, post-graduate and even undergraduate programs guide these students toward Reiki, meditation, etc., or other strange techniques that resemble the training of dogs, horses, and other animals without language. I have nothing against that! All practices are welcome. But this is not psychology. Let's not confuse the objects or methods, and what we're talking about: Psychology as a science and as a profession should be far beyond that.

All this leads me to think that, 90 years after Vygotsky's "The Historical Meaning of the Crisis in Psychology", a dialogue with the author of that text is still very current and necessary. Perhaps we can even say it's mandatory. And certainly it will cause many more to be happy with our work, because then we can see the product of what we do with Psychology, with a new practice of psychological work.

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NEUROPSYCHOLOGY

Psychophysiological methods for the diagnostics of human functional states: New approaches and perspectives

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L. S. Vygotsky in his famous methodological essay "The historical meaning of psychological crisis" (1928) emphasized the importance of studying any psychological process or state as a "whole" — that is, as characterized from the subjective and objective sides at the same time. This position is fully relevant for studying the human functional states (FSes). Today the objective psychophysiological diagnostics of human FSes in activities associated with a high risk of technological disasters (in nuclear-power plants, transportation, the chemical industry) are extremely relevant and socially important. This article reviews some new psychophysiological methods of FS assessment that are being developed in Russia and abroad and discusses different aspects of developing integral psychophysiological FS assessment. The emphasis is on distant methods of FS diagnostics: the bioradiolocation method, laser Doppler vibrometry, eye tracking, audio and video recordings, infrared thermography. The possibilities and limitations of the most popular emotion atlases — the Facial Affect Scoring Technique (FAST) and the Facial Action Coding System (FACS) — in developing distant visual-range and infrared-range systems for automated classification of facial expressions are analyzed. A special section of the article concentrates on the problem of constructing an integral psychophysiological FS index. Mathematical algorithms that provide a partition of FS indicators into different FS types are based on various methods of machine learning. We propose the vector approach for construction of complex estimations of the human FSes.

Keywords: functional states, distant diagnostics, integral estimating, vector approach

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Introduction

In general, *functional state* (FS) is defined as a state of the mental and physiological activity of a person against which one or another professional activity is implemented (Danilova, 1992; Leonova, 2007, 2009; Leonova & Kuznetsova, 2015). In physiology, FS is closely associated with the level of activation (excitation/inhibition) of the nerve centers. In accordance with this interpretation, FSes are considered "functional states of the brain" and are presented as values on a "sleep-wake" scale (Danilova, 1992). Psychologists added psychological factors to physiological FS determinants: for example, motivation, activity content, individual characteristics of mental processes and states (Leonova, 2007, 2009; Leonova & Kuznetsova, 2015). As a result the set of physiological FSes (sleep, wakefulness, fatigue, monotony, slumber) was completed with such psychophysiological FSes ("psychoemotional states") as emotions, psychological stress, altered-consciousness states, anxiety, fears, depression.

The problem of objective (psychophysiological) human FS diagnostics in different modes of behavior associated with the high risk of technological disasters (in nuclear-power plants, transportation, the chemical industry) is extremely relevant and socially important. A critical factor in determining the efficiency of an activity is the "optimal (for this activity) human FS". Deviation from this factor leads to serious failures (Chernobyl, Fukushima-1). The European Union spends tens of millions of euros for development of this urgent topic (for example, the international project "Advanced sensor development for attention, stress, vigilance, and sleep/wakefulness monitoring"). Starting in 2004 within NATO scientific and technological programs Operator Functional State Assessments have been performed. Applied studies related to the development of objective and distant FS identification methods in real-time mode are of particular interest. In the struggle against terrorism the development of optical-electronic equipment and software for identifying FSes based on individual behavioral characteristics and appearance turns out to be a task for fundamental and applied psychophysiology.

Bioradiolocation of FS indicators

Bioradiolocation is held to create new distant methods for human FS identification on the basis of such physiological parameters as heart rate and breathing, which are usually controlled by contact sensors. Four groups of biomechanical movements generate the signals recorded by radar methods: (1) contraction of heart muscle (of 0.8–2.5 Hz, thorax oscillation amplitude is 0.1 mm); (2) vibrations of thorax during breathing (0.2–0.5 Hz, oscillation amplitude is 0.5–1.5 cm); (3) the movement of organs of speech (the basic tone oscillation frequency of vocal cords equals about 100 Hz), and (4) movements of head, lips, hands, and feet (Bugaev, Ivashev, & Immoreev, 2010). Ultra-wideband (UWB) radar) for remote measuring of cardiac activity and respiration has been developed and tested (Immoreev, Isaychev, Samkov, & Pavlov, 2010). Radar belongs to the class of ultra-wideband when the impulse length in space (impulse duration × speed of light) becomes comparable to or less than the spatial extent of the observed object. UWB radar significantly increases resolution and the accuracy of the measurement of the distance to the monitoring object, decreases the radar "dead zone", increases resistance to all types

of passive interference, and simplifies monitoring of a moving target against strong reflections from stationary objects in the background. To evaluate the accuracy of the measurements obtained by using UWB radar and the quality of playback information about cardiac activity, a special study comparing the signals captured by UWB radar with the signals of an electrocardiograph was carried out (Immoreev et al., 2010). Value distributions of instantaneous (from beat to beat) changes in the period of cardiac contractions were compared. The correlation coefficient between these two measurement methods was ~ 0.91, and the average measurement error was less than 3%. Results of these experiments confirm the possibility of using UWB radar for monitoring human cardiac activity and respiration rate. Such properties of UWB radar as noncontact, remoteness of measurements, device portability, easy maintenance and handling make this method promising and reliable for use in systems for remote FS diagnostics.

Laser Doppler vibrometry

Laser vibrometry is designed for remote measurement of vibration velocity (vibrooscillations) of the test object or a part of it in the range from 0.01 to 50 mm/s on frequencies of vibration from 80 Hz to 11 kHz. The working distance for the measurements between the laser vibrometer and the object ranges from 1.5 to 10 m and more. The first domestic portable laser vibrometer with increased sensitivity was developed by JSC FSPC NSRP "Quartz" (http://www.kvarz.com/general/aboutR.html). The working principle of the laser vibrometer is the Doppler shift of radiation of optical (laser) frequency reflected from a moving object. In fact, laser Doppler vibrometry (LDV) is close to widely used methods in human psychophysiological studies such as accelerometry and plethysmography, which in contact application convert signals about changes in skin state to information about the state of the physiological processes that caused these changes. Use of LDV allows one to register a greater number of physiological parameters than does radar. In particular, by using LDV it is possible to measure muscle tension, heart rate, heart tones, and various respiratory parameters. With LDV it is possible to register muscle tension in the form of an "acoustic myogram", which correlates well with regular EMG and can be used to determine patterns of the activity of facial mimic muscles corresponding to the expression of different emotions. It is important to note that LDV signals are weakly influenced by various noises and other external conditions.

Oculomotor activity and pupillary response

Methods for eye-movement detection have been effectively used in experimental psychology for over half a century. Eye-tracking units operate on the principle of videooculography, the essence of which is video registration of pupil shifts and glints arising on the cornea because of infrared radiation directed into the eye. Glint, formed on the cornea, is recognized by video camera as a bright spot, and the pupil is detected as a black one. Moreover, the position of an infrared backlight is analyzed, and thus it becomes possible to determine the orientation of the eyeball optical axis. The main task of eye tracking is the real-time (with a frequency of 250 Hz) registration and transfer of data about eye movements. Eight types of human

eye movements are known; of these fixations and saccades are of the greatest interest to psychophysiologists. Eye fixations are the complex of micromovements in a small spatial area consisting of microsaccades (fast jumps with angular speed up to 200 °/s), drift (slow movements with speed below 0.5 °/s), and tremor (quick eyeball trembling at a rate of 30-80 c/s) (Barabanschikov & Milad, 1994; Barlow, 1952). Fixation (as a certain part of the drift) is the drift — that is, the slow and smooth eye movement — in a small spatial area (Barabanschikov & Milad, 1994). It is considered that during fixation receipt the processing of visual information occurs. Saccades are sudden eye leaps that change the eye position and, as a consequence, change the location of the focus of visual attention ("the zone of clear vision"). Oculomotor activity is determined by the current task, and study of its dynamics opens up the possibility for the objective study of cognitive-perception processes (image construction). Initially, the main task of eye tracking was to study the psychological patterns of visual perception (Klingner, Kumar, & Hanrahan, 2008). Numerous studies have shown that eye movements are critically related to many aspects of visual perception (Wade & Tatler, 2005; Yarbus, 1967), attention (Hoffman & Subramaniam, 1995), and different types of psychological disorders (Kovalev, Klimova, & Menshikova, 2016; Menshikova, Kovalev, Klimova, & Chernorizov, 2015; Shapiro, 1989).

The reflex reaction of the constriction/extension of pupil diameter (RPD) can be used as one of the indicators of distantly registered electrooculography for FS diagnostics. Anatomically and functionally the RPD is under the control of antagonistic effects of sympathetic and parasympathetic autonomic-nervous-system divisions. The RPD is affected by a number of factors related to the influence of external stimulation (light, contrast, duration) as well as to individual characteristics of the response subject (emotionality, cognitive processes, fatigue) (Fukuda, Stern, Brown, & Russo, 2005). According to some researchers, RPD can also be effectively used for stress diagnostics in lie detection (Heaver & Hutton, 2011). Currently a method of complex FS diagnostics based on a combination of eye tracking with EEG-analysis data is being developed.

Diagnostics of psychoemotional states according to facial expression

Facial expressions are an important source of information about human emotions, intentions, and affective states. In this regard, their analysis is increasingly being used in brain-computer interfaces along with analysis of audio signals and body movement (postures, gestures) (Ekman, 1999).

Emotion atlases FAST and FACS

Based on studies of the expression and perception of human emotions carried out using the method of visual analysis (classification) and the method of registration and analysis of mimic-muscle activity, P. Ekman and colleagues developed two human "atlases of emotions" — the Facial Affect Scoring Technique (FAST) and the Facial Action Coding System (FACS) (Ekman, Friesen, & Hager, 2002; Ekman, Friesen, & Tomkins, 1971). In the FAST atlas sketches of emotional expressions for

three levels of the face (eyebrows and forehead, eyes and lids, lower part of face) were presented for different gaze directions and head orientations. The FACS atlas is a complete description of the activity patterns of certain facial muscles, made on the basis of individual facial muscles' registration of electrical activity during the expression of different emotions. In the FACS atlas nearly 10,000 patterns of facial muscle activity are presented, and the relation of these patterns to different emotional expressions is established (Ekman et al., 2002). Thus, according to the FACS atlas, muscular correlates of the sign and the intensity of expressed (experienced) emotion are a specific combination (pattern) of the activity of facial muscles and the magnitude of this activity, respectively. FAST and FACS atlases are widely used for studying emotions in fundamental psychology, for training profilers in applied psychology (Turvey, 2012), and for developing systems for automated facial-expression classification and automated affect recognition in artificial-intelligence programs (as described in the following two sections).

Visible-range systems for automated facial-expression classification (AFEC) and systems for automated affect recognition (AAR)

Technical intelligence systems with elements of automated facial-expression classification (AFEC) and automated affect recognition (AAR) can be effectively applied not only in artificial intelligence but also in modern detectors of hidden knowledge based on analysis of thermal signals from facial muscles (Pavlidis, 2004). In the field of recognition of faces and emotional facial expressions there are two main approaches: visual and thermal. The visual approach analyzes the usual video sequence; the thermal approach analyzes video obtained from thermal imaging cameras that are able to capture infrared radiation from the human face.

Most modern AFEC devices are based on the analysis of video data (visual-based AFEC, vAFEC) (Abidi, Huq, & Abidi, 2004). The reliability of these systems in emotion recognition based on visual face images reaches 70%. The theoretical basis for such systems and the mathematical algorithms and technical components used to create them are described in reviews by Pantic and Rothkrantz (2000). Despite their relatively high accuracy in emotion recognition in laboratory conditions, AFEC systems of this type are inefficient in field conditions for the following reasons (Fasel & Luettin, 2003): the impact of changes in the intensity of background light, the dependence of the accuracy of identification on pose, and the accuracy of the face-structure model used in the algorithm for emotion recognition. The limitations of visually oriented AFEC and AAR systems in real conditions were also not removed when they were used as a reference database for recognition of faces from the FACS atlas. All these difficulties are triggers for the development of AFEC systems based on other types of (nonvisual) information (nonvisual-based AFEC, nvAFEC) or based on a combination of visual and nonvisual signals (for example, thermovision and/or acoustic signals) (Christie & Friedman, 2004). In most vAFEC visual evaluation of facial muscles, movement is used. All types of observed movements of facial muscles are usually divided into four groups: static (tonic) signals, reflecting the stable properties of the activity of facial muscles; gradual (slow) changes in muscle activity that contribute to overall facial expression; artificial signals (artifacts) associated with the peculiarities of hair covering,

glasses, and jewelry; fast signals, reflecting changes in neuromuscular facial activity (clenching of jaws, opening of mouth). In the FACS atlas fast signals are the basis for encoding emotions.

In addition to the FACS atlas two other methods are used in systems of emotion recognition based on facial expressions: optical flow analysis and the 3D wireframe face model. Optical flow analysis (OFA) is based on measurement of local changes in "face-image" brightness arising from the activity of facial muscles (De Carlo & Metaxas, 2000). The accuracy of this method for classification of emotions varies in rigidly controlled test conditions from 80% to 98%. The 3D wireframe face model is more accurate than the OFA method but requires large calculations (Gur et al., 2002).

Common drawbacks of visual methods for detecting facial expression are low efficiency in conditions of weak and/or uneven illumination and the dependence of expression-identification reliability of the same person on shooting angle.

Infrared-range systems for automated facial-expression classification (AFEC) and systems for automated affect recognition (AAR)

Infrared thermography is a method of remote visualization and registration of object thermal fields within the range of electromagnetic waves of infrared radiation from 770 nm to 1000 microns. Thermography is a powerful research tool used in almost all fields of natural science — medicine, geology, biology, energy saving, nondestructive testing (Vavilov, 2013). Increased interest in thermography is connected with the appearance of a new generation of thermal imagers and modern methods of digital processing, analysis, and storage of thermographic images.

One of the most important applications of thermography is noncontact registration of psychophysiological parameters through systems of distant detection and identification of human appearance and behavior features in situations of anxiety, increased emotional excitement, and stress. Human skin has high emissivity, close to absolute blackbody. Therefore, a change in its temperature leads to a significant change in the power of emitted infrared radiation. Low reflectance of skin minimizes the environmental influence on the detection of skin temperature. In thermographic imaging low reflectance allows accurate capturing of local temperature changes.

Cardone, Pinti, and Merla (2015) review the main achievements of thermography in human FS monitoring. They also provide strong evidence of the ability to use infrared images as the basis for a quantitative estimate of such autonomic-nervous-system activity parameters as local blood perfusion, heart rate, and respiratory rate. Pavlidis & Levine (2001) show that the level of perfusion in the eye-socket region allows the registration of small temperature changes associated with human FS. Puri, Olson, Pavlidis, Levine, and Starren (2005) discovered that the rectangular forehead area containing central vessels is the most informative for stress diagnostics. A number of studies suggest that one of the most informative methods for human FS evaluation is remote thermographic analysis of breathing flows. For example, Lewis, Gatto, and Porges (2011) provide experimental data showing that infrared thermography allows sufficiently accurate evaluation of breathing rhythm and relative tidal volume.

Study of facial thermal radiation by infrared cameras (thermal imagers) to develop infrared-range AFEC and AAR is a new and actively developing area at the intersection of fundamental science and practice (Jarlier et al., 2011; Kong, Heo, Abidi, Paik, & Abidi, 2005). This method is the most promising and rapidly developing technique for the distant detection of emotions. Temperature mapping has a high temporal resolution and allows identification of face features and expressions in low-light conditions. Generally, a thermovisor is used in combination with a regular video camera. The facial image in the visible range has more pronounced details that allow more accurate determination of interesting facial areas on the image; it compensates for possible distortions, such as head rotation and mimic distortions, and allows more accurate estimation of the distortion parameters. Such imaging requires the performance of two tasks: (1) searching for a face in the image according to basic contours and points (eyes, nose); (2) describing face parameters (eye contours, eyelids, eyebrows, lips, nose wings) in detail. Special biometric software has been developed to perform these tasks. Detailed evaluation of face rotation and detection of biometric (mimic) control points on the face are done using Active Appearance Models (AAM) (Leinhart & Maydt, 2002) and Active Shape Models (ASM) (Cristinacce & Cootes, 2007). Combining data from AAM/ASM models with a thermal image allows more accurate determination of the location of the desired temperature control points on the thermal image (Wang, He, Wu, He, & Ji, 2014). These methods also allow evaluation of human facial expressions, and the information can be used to assess emotional states (Huang & Ren, 2013). Use of these methods on a video sequence allows one to track control-point trajectories in space and to evaluate dynamic characteristics of facial expressions.

In experiments on rats (Vianna & Carrive, 2005), monkeys (Nakayama, Goto, Kuraoka, & Nakamura, 2005), and humans (Puri et al., 2005) the possibility of using facial thermal mapping for emotion and stress diagnostics has been demonstrated.

Avinash, Buddharaju, Pienta, & Pavlidis (2012) compared the effectiveness of methods for recognizing facial features and expressions using data from infrared video, ordinary video, or both on the basis of the FACS atlas recognition system. The comparison was based on an analysis of 13 facial regions of interest (ROIs) that are critically important for the recognition of basic emotions (Ekman et al., 2002). For each ROI the average value of the parameters was extracted, and then principal-component analysis was used to identify the degree of deviation of each of the 13 regions from neutral facial expression. It turned out that under different levels of illumination but constant temperature the thermal method was better than the visual method, as was expected. Under conditions of constant illumination and variable temperature (a fan with heated air of varying intensity was directed on the face of the subject) the visual method showed greater efficacy, whereas the performance of the thermal method, contrary to expectations, remained virtually unchanged. The authors note that if we consider the visual and the thermal methods separately, not in combination, temperature mapping is preferable. However, for the most effective identification of facial features and emotional expressions the combination of thermal and visual methods is optimal (Avinash et al., 2012).

A modern cross-cultural research challenge for the universality of emotional communication: Does culture shape how we look at faces?

Fundamental cross-cultural studies of emotional expression among representatives of more than 20 countries of East and West showed that facial expressions of basic emotions do not depend on culture and are universal for humans (Ekman, 1999). Studies of facial emotional expressions among chimpanzees have confirmed the ideas of Charles Darwin and P. Ekman about the evolution of emotional communication in primates and served as the basis for the creation of the Chimpanzee Facial Action Coding System (ChimpFACS) (Parr, Waller, Vick, & Bard, 2007). The ChimpFACS is an objective, standardized observational tool for measuring for facial movements in chimpanzees based on FACS (Ekman et al., 2002). This tool enables direct structural comparisons of facial expressions between humans and chimpanzees based on their common underlying musculature. The authors provided data on the application of the ChimpFACS to validate existing categories of chimpanzee facial expressions using discriminant-functions analyses. As a result, the authors suggested a potential homology between these prototypical chimpanzee expressions and human expressions based on musculature.

However, works have now appeared the results of which indicate cross-cultural differences in ways of expression and the perception of emotions (Engelmann & Pogosyan, 2013; Park, Barash, Fink, & Cha, 2013). Such cultural distinctions may lead to missed cues or misinterpreted signals about emotions during cross-cultural communications. These data challenge the common theory that facial expressions are a hard-wired human behavior with solely evolutionary origins and therefore facial expressions do not differ across cultures. These data on the cultural influence on expression and perception are not doubted. The only question debated is how these influences apply to the so-called basic emotions (Ekman, 1999). The answer to this question is important for understanding whether (and how) to consider the impact of cultural differences on emotional communication in emotion atlases (FAST, FACS) and systems of automated emotion recognition (AFEC, AAR).

Diagnostics of human psychoemotional states using speech analysis

A number of psychophysiological data show that each human emotion has its specific sound expression, which is manifested in the change of so-called vocal utterance — tone, rhythm (tempo), and timbre (Potapova, Potapov, Lebedeva, & Agibalova, 2015). Psychologists and psycholinguists suppose that about 90% of emotional communication occurs on the nonverbal level. For example, although speech is perceived regardless of its content, we can discover the emotional state of the person (for example, melancholy or anxiety) based on such indicators as the rate and average duration of pure speech, the length of pauses, the ratio of pause time to total time of utterance, the speed of articulation, hesitations, the character of respiratory movements, voice pulsation related to blood flow, changes in the main tone of voice, and the analysis of vibrations of the vocal-apparatus muscles (Bachrowski & Owren, 2003; Lebedeva & Karimova, 2014; Potapova et al., 2015). The restriction of voice analyzers of emotions is a requirement for well manifested (clearly, loudly) verbal expressions; this requirement limits application of this method in field conditions.

Hardware-software complexes for distant registration of FS parameters

Currently, the market for commercial services for distant FS diagnostics presents a limited number of choices. The most famous is a product of Siemens VDO, the Driver Attention System (DAS). Based on a driver's facial expression and eye movements, a DAS camera placed on the dashboard monitors FSes (on the scale sleep-wake) during car movement and, in case of deviations from the norm, it beeps to the driver (http://techfreep.com/automatically-adjust-to-speed-limits-with-siemens-car-camera.htm).

In Russia, scientific and applied research and development of systems similar to DAS are only beginning. One of them, VibraMed, is a system for the analysis of human psychophysiological and emotional states ; it was developed by Elsis (in St. Petersburg, Russia) (Minkin, 2007). The system is based on the registration of the frequency and amplitude of human head micromovements ("vibroimages of human head"). Vibroimaging registers micromovement and spatial oscillations of the object by determining the vibration parameters (frequency and amplitude) for each element (pixel) of the test image. The theoretical basis of the method is that the vestibular system is linked to all other functional systems of the human body and responds promptly to any mechanical, level-of-pain, or emotional change. According to the author, head-vibration parameters (frequency range 0.1–10.0 Hz and amplitude in the range of 10–1000 μm) for the steady emotional state of a person are stable over time. Vibration parameters fluctuate only after a change in emotional state. At this time the link of emotions to head micromovements cannot be considered to be sufficiently studied and unambiguous. For example, the VibraMed program promises quantitative evaluation of such human qualities as health, extraversion, and anxiety. However, these characteristics are intrinsically integral and reflect the complex interaction of multiple physiological and psychological processes that cannot be tested using only one physiological index.

Developments in the integral psychophysiological evaluation of FSes: Challenges, approaches

Existing contact and distant FS monitoring technologies face the following major problems: (1) the difficulty of taking individual differences into account; (2) the variability of psychophysiological characteristics corresponding to one FS type, which lies within its "corridor" around an unknown centroid corresponding to the characteristics typical for it; (3) developing and adjusting reliable mathematical data-processing algorithms for providing accurate classification of FSes in real time; (4) the forecasting and predicting FS changes in the release of psychophysiological characteristics beyond the limits acceptable for the given type of FS.

In order to solve these problems we propose a vector approach based on the presentation of multiple psychophysiological characteristics (FS indicators) as a vector, the n dimension of which is determined by a number of psychological (tests) and physiological (heart rate, galvanic skin response, EEG) indicators (Lebedev, Isaychev, Chernorizov, & Zinchenko, 2013). Vector elements can be both standard "first-level" characteristics and characteristics obtained from less standard signal processing (for example, coefficients of EEG signal decompo-

sition). A set of such vectors forms the *n*-dimensional space of FS indicators, where each FS type has its own spatial area formed by a set of vectors corresponding to its type. An FS-indicator space-location characteristic (for example, metric) is introduced and is formulated based on its algorithm, which determines FS classification by correlating measured FS indicators, represented by the corresponding *n*-dimensional vector, with one or another space area. Such a model of integral FS evaluation opens the following possibilities for solving FS monitoring problems:

(1) Spatial areas can be determined for each person separately according to individual characteristics; this procedure eliminates the problem of individual differences.
(2) FS localization in separate spatial areas allows determination of the centroid for each FS type; the centroid reflects both the indicator values typical for the given FS type and the oscillation limits beyond which a transition to another FS type occurs.
(3) The trajectory of vector displacement in an FS indicator's space allows estimation of the sustainability level of the FS type and forecasts of the direction and the probability of change of the FS type.
(4) Multivariate analysis (multidimensional scaling, factor analysis) can provide a reasonable reduction in the number of registered signals and FS indicators without reducing the reliability of the determination of FS type.
(5) The accumulation of training samples refines the true partitioning of an FS indicator's space to areas corresponding to given FS types; this procedure results in the increased accuracy of the determination of FS type.
(6) The geometric model of FS space allows the visualization of results in the context of psychological and psychophysiological training, which can be used in developing skills for FS self-regulation.

The high efficiency of the vector approach was successfully demonstrated in the field of sensory and cognitive psychophysiology (Sokolov, 2013), as well as in human FS diagnostics (Lebedev et al., 2013).

Algorithms that provide a partition of an FS indicator's space into areas corresponding to different FS types may be based on various methods of machine learning: for example, clustering methods, neural networks, the method of support vectors, decision (random) trees, random forests. We have developed a specialized method for the automated construction of classifier functions for binary FS classification; it provides reliable classification of stress vs. state-of-calm wakefulness (also referred to as a normal FS) despite the relatively small size of learning samples (Galatenko, Livshitz, Podolskii, Chernorizov, & Zinchenko, 2012). Along with an efficient procedure for dimension reduction that utilizes discrete wavelet transform, this method includes an individual tuning stage that allows the inclusion of certain information on individual peculiarities in the classification. This stage additionally requires only a short learning sample for an individual, which significantly increases the reliability of the FS classification (Galatenko et al., 2013). The significance of an individual tuning stage has also been observed for a completely different method of FS classification based on the integrated analysis of pe-

ripheral physiological parameters (Lobacheva et al., 2013). These results provide a basis for the conclusion that using an individual tuning stage, which is not standard for classical machine-learning methods, is natural and efficient when mathematical methods for FS classification are employed.

Conclusion

In full accordance with the ideas of L.S. Vygotsky, the main trends in the development of modern approaches to FS diagnostics concentrate on the integration of psychology and natural science (neuroscience, mathematics). These trends are connected with the construction of complex psychophysiological expert systems for FS diagnostics based on multidimensional analysis in real time of both psychological and physiological data. From our point of view, the vector metric model for the representation of FS parameters, combined with methods of multivariate analysis, is the most promising tool for building an integral process for the evaluation and classification of FS.

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Face cognition in humans: Psychophysiological, developmental, and cross-cultural aspects

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Investigators are finding increasing evidence for cross-cultural specificity in face cognition along with individual characteristics. The functions on which face cognition is based not only are types of general cognitive functions (perception, memory) but are elements of specific mental processes. Face perception, memorization, correct recognition of faces, and understanding the information that faces provide are essential skills for humans as a social species and can be considered as facets of social (cultural) intelligence. Face cognition is a difficult, multifaceted set of processes. The systems and processes involved in perceiving and recognizing faces are captured by several models focusing on the pertinent functions or including the presumably underlying neuroanatomical substrates. Thus, the study of face-cognition mechanisms is a cross-disciplinary topic. In Russia, Germany, and China there are plans to organize an interdisciplinary cross-cultural study of face cognition. The first step of this scientific interaction is conducting psychological and psychophysiological studies of face cognition in multinational Russia within the frame of a grant supported by the Russian Science Foundation and devoted to "cross-cultural tolerance". For that reason and in the presence of the huge diversity of data concerning face cognition, we suggest for discussion, specifically within the psychological scientific community, three aspects of face cognition: (1) psychophysiological (quantitative data), (2) developmental (qualitative data from developmental psychology), and (3) cross-cultural (qualitative data from cross-cultural studies). These three aspects reflect the different levels of investigations and constitute a comprehensive, multilateral approach to the problem. Unfortunately, as a rule, neuropsychological and psychological investigations are carried out independently of each other. However, for the purposes of our overview here, we assume that the main factors that could influence the developmental, individual psychophysiological, and cross-cultural differences in face cognition are not only biological but also social and cultural. One of the principal tasks of this article

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is to draw the attention of psychologists to the physiology of face processing and to draw the attention of neuroscientists to the psychology of face cognition. Thus, the main goal of the article is to instigate a discussion among social psychologists, psychophysiologists, and neuroscientists about the mechanisms of face cognition, which, as in a mirror, reflect the basic, fundamental "psychophysical" problem of psychophysiology.

Keywords: face cognition, social psychophysiology, development, other-ethnicity effects, brain mechanisms

Psychophysiological aspects of face cognition

The functional architecture and neural basis of the face-selective system in the human brain

Since the 1990s, brain mechanisms for face processing have been an area of high interest within psychophysiology and neuroscience. In the ever-growing body of research are the anatomical and physiological organization of the mechanisms underlying face perception and memory; the brain algorithms for detecting and identifying faces; the neural basis of face perception in humans and animals; the congenital and acquired disorders of face perception; and the brain mechanisms of cross-cultural differences in face perception and emotion recognition.

According to contemporary psychophysiological data (neuroimaging, electroencephalography, behavioral and clinical evidence), processing of faces can be divided into perceptual processing (detection of faces) and conceptual processing (identity of faces and facial expression) (De Haan, 2011; Tsao & Livingstone, 2008). In humans, a distributed neural network, involving the subcortical pathway (SP) and cortical areas (CAs), mediates these processes.

The SP (retina, superior colliculi, pulvinar of the thalamus, amygdala) is believed to process the basic features of faces quickly and automatically — that is, preattentively and unconsciously (for a review, see De Haan, 2011).

According to the widely known and cited functional model of the distributed human neural system for face processing, proposed by Haxby and Gobbini (2011), the face-selective CAs are divided into the Core System (CS) and the Extended System (ES). The CS includes the inferior occipital gyrus (occipital face area, OFA), the middle-lateral fusiform gyrus (fusiform face area, FFA), and the face-selective parts of the superior temporal sulcus (fSTS) and the superior temporal gyrus (fSTG). There is evidence that the FFA supports analysis of the invariant (static) components of faces (recognition/discrimination of individuals), while the STS and the STG are involved in the interpretation of changeable (dynamic) aspects of face processing (perception of facial expression, eye gaze, lip movements). Via forward and backward routes, the ES communicates with both the SP and the CS. It encompasses the amygdala, hippocampus, inferior frontal gyrus, medial orbitofrontal cortex, and anterior cingulate cortex (De Haan, 2011; Haxby & Gobbini, 2011). The networks of the ES are involved in the conscious interpretation of emotional states and the intentions of others in order to control and plan behavior in social situations.

As revealed by studies with functional magnetic resonance imaging (fMRI), the face-selective brain areas are activated more when humans are viewing human faces

than when they are viewing other visual objects — letter strings, textures, flowers, houses, hands. The most robust face-selective activation is found in the FFA, which maximally responds to a wide variety of face stimuli: photos of familiar and unfamiliar faces, schematic faces, cartoon faces, animal faces, as well as faces presented in different sizes and locations, and from different viewpoints (Kanwisher & Dilks, 2013; Tsao & Livingstone, 2008). Although viewing faces evokes bilateral activation within all face-responsive regions, stronger responses have been found in the right hemisphere (Ishai, 2008).

Another portion of data, pertaining to the specificity of the face-selective CAs, comes from studies that used transcranial magnetic stimulation (TMS) to examine face processing. Pitcher, Walsh, and Duchaine (2011) used TMS to disrupt CAs implicated in the recognition of faces: the OFA, the face area in the right somatosensory cortex, and the STS. While stimulating the OFA, they discovered a temporally discrete impairment window from 60 to 100 ms. The TMS data that provide evidence that the OFA processes faces in a discrete temporally early period correspond closely to time-locked features of the face-sensitive N170 component of evoked response potential (ERP). The N170 is an ERP peaking 170 ms after stimulus onset; the response is stronger to faces than to objects (Eimer, 2011). This 170-ms face-selective time window may be formed as follows: detection and crude affective categorization occur rapidly, from 100 ms post-stimulus onset, with fine-grained cortical representations necessary to recognize identity and to discriminate between basic emotional expressions computed within an additional 70 ms (Palermo & Rhodes, 2007).

Feature-based and holistic-based algorithms for face cognition

The fundamental question in modern research on face processing is how the brain extracts and interprets the various facial properties from a single visual image. At present feature-based or holistic-based algorithms for the identification of individual faces are being discussed most actively (Sokolov, 2013; Tsao & Livingstone, 2008). The feature-based algorithm starts with identification of the fiducial face points (eyes, mouth, nose) in order to compute various geometric ratios. In a holistic algorithm, the entire face is matched to memory templates ("face-filters") without isolating specific features or parts. The first algorithm is robust in regard to position and scale variations, and the advantage of the second is that all parts of the face are used, and no information is discarded. Extensive psychophysiological evidence now shows that face processing uses both feature-based and holistic-based algorithms. For example, the FFA exhibits sensitivity to differences in face identity for upright but not inverted faces and sensitivity to holistic information in upright but not inverted faces; it thus favors the gestalt-based algorithm (Kanwisher & Barton, 2011; Kanwisher & Dilks, 2013). From another side, FFA responses show some invariance across changes in stimulus position and image size, and thus they reveal the advantages of the feature-based approach (Kanwisher & Barton, 2011). The face-selective neurons ("gnostic neurons") in human amygdala appear to represent perceptual information about face shape in a fashion invariant to image changes — that is, in a holistic way (see the "neuron-detector of Bill Clinton" in Kreiman, Fried, & Koch, 2002).

Do face cognition and objects' processing involve different visual networks in the brain?

Although the CS and the ES show the strongest activation in response to faces, they also respond to nonface objects (houses, chairs, tools), thus ruling out their status as "face modules" (Ishai, 2008; Tsao & Livingstone, 2008). In this connection, two alternative hypotheses are now being discussed. According to the first, the expertise hypothesis (EH), the FFA is engaged not in processing faces per se but rather in processing any sets of stimuli that share a common shape and about which the subject has gained substantial expertise (Tarr & Gauthier, 2000). The second hypothesis, the distributed-coding hypothesis (DCH), argues that objects and faces are coded via the distributed profile of neuronal activity across much of the ventral visual pathway (Haxby & Gobbini, 2011). The numerous results of fMRI, single-cell recording, TMS, and neuropsychology, taken together, make the argument that faces are "special" because of the tight clustering of face-selective neurons and thus they argue against EH. Moreover, these results indicate dissociations not only between faces and objects in general but also specifically between faces and other parts of the body (head, hands). The most effective pro-DCH argument came from a neuropsychological case study: Moscovitch, Winocur, and Behrmann (1997) described a striking agnosia of a patient who was severely impaired in regard to object recognition but nonetheless was 100% normal in regard to face recognition. Such a pattern of deficits indicates that in the visual hierarchy face processing is a completely different pathway that branches away from object recognition early (for a discussion, see Jansari et al., 2015). From another side, it has been compellingly shown that expertise, attention, visual imagery, emotion, contexts of whole bodies, emotional voices, and natural scenes modulate activation of the FFA (de Gelder & Van den Stock, 2007; Palermo & Rhodes, 2011). Thus, the results of the research projects briefly reviewed here appear conflicting, and there does not seem to be a simple answer as to whether the EH or the DCH is true.

Face processing in social cognition and social communications

Brain areas for face processing, along with other modalities, are actively involved in social cognition and social communications (Chernorizov, Asmolov, & Schechter, 2015; Zinchenko & Pervichko, 2013). They derive information about a person's identity and emotional state, gender and age, array of verbal and nonverbal (gestural) social signals, eye-gaze processing in face-to-face situations, capacity to understand people's intensions and desires, and impressions of others' attractiveness and trustworthiness (Bate & Bennett, 2015; Rolls, 2011; Soto & Wasserman, 2010). A large number of psychophysiological studies suggest that social cognition and communication strongly engage such parts of the brain as the amygdala, insula, fSTS, FFA, and OFC (Adolphs & Birmingham, 2011; Haxby & Gobbini, 2011). For example, information about a facial expression that is conveyed unconsciously via SP to the amygdala may be sufficient only to discriminate emotional (more arousing) from unemotional (less arousing) faces (Palermo & Rhodes, 2007). In modern social neuroscience a new line of research is evolving that focuses on how human beings recognize individual faces of their own race versus faces of individuals in another "racial group." This research centers on the brain mechanisms of the well-

known phenomenon that people have greater difficulty distinguishing and recognizing individual faces from a different human population (the "other-race effect") than from their own ("in-group favoritism"). Some fMRI and ERP studies suggest that the expertise-dependent development of holistic processing of the FFA, from infancy through childhood, plays an important role in the recognition of familiar and unfamiliar faces of our own race and of other races (Jakobsen, Umstead, & Simpson, 2016; Rossion & Michel, 2011).

Developmental aspects of face cognition

General psychological findings from studies of the specificity of face cognition in adulthood

Face cognition — the ability to perceive and discriminate, to memorize and to correctly and rapidly recognize faces, and to understand the diverse information that faces provide — is one of the most valuable sets of skills for humans as social beings.

Since the days of Francis Galton, psychologists have been aware that a face is not identified by recognition of its isolated features but by the integration of these features into a perceived whole (Tanaka & Gordon, 2011). This face-specific strategy has been called holistic processing. According to models of face cognition (Bruce & Young, 2012) face perception starts with structural encoding — that is, extracting pictorial and structural codes from faces and maintaining them for a short period of time for subsequent recognition.

Psychological, clinical, phylogenetic, and neuroimaging studies have demonstrated that face cognition is a specific process and is connected more with social intelligence than with general cognitive processes (Bruce & Young, 2012; Wilhelm et al., 2010). Hildebrandt, Wilhelm, Schmiedek, Herzmann, and Sommer (2011) showed that this differentiation between general cognitive abilities and face cognition persists into old age. But what about the development of face processing?

The development of face cognition

The development of face cognition in childhood and adolescence is of interest to many researchers today. However, there are still many unresolved controversies. Already newborn infants show a preference for moving, schematic faces (Goren, Sarty, & Wu, 1975). One proposed explanation is a preference of the immature visual system for (top-heavy) patterns with an emphasis in the upper visual hemifield (Simion, Valenza, Cassia, Turati, & Umilta, 2002). Quinn, Yahr, Kuhn, Slater, and Pascalis (2002) found a preference in infants for the faces of wild cats, which the authors explain through the same mechanisms that supposedly drive the preference for female human faces (cats faces have some feminine traits). This mechanism is based on the early preference of infants for their mothers' faces. Infants are able to recognize their mothers' faces from different perspectives and to process the configuration of their faces (Rose, Feldman, Jankowski, & Van Rossem, 2008).

Because of many difficulties in the organization of the investigation of the development of face cognition, there are different interpretations of experimental

findings. In the following sections, we discuss some major controversies in theories about the development of face cognition.

Controversies in research on the development of face cognition

Early versus late maturity of qualitative development. In discussing the qualitative development of face cognition, it is important to recall the classical encoding-switch hypothesis of Carey and Diamond (1977). Their main thesis is that face cognition matures late — during late adolescence — and this process is related to social experiences.

These initial suggestions about the late maturation of face cognition were strongly criticized. One of the points was connected with "own-age bias" — that is, it is easier to recognize persons from one's own age group (Anastasi & Rhodes, 2005). In Flin's work (1985) faces of classmates of children were used, and performance was much higher than in classic studies. This finding was crucial for changing views on the development of face cognition.

The current position is based on experimental evidence (psychological, clinical, phylogenetic, neuroimaging) of the specificity of face cognition and holds that it is possible to observe specific mechanisms already in early childhood, but these mechanisms continue to mature until late adolescence. Alternative positions are based on a theory of general development; proponents claim the early maturity of face cognition already at 4–5 years and relate this process to general cognitive abilities (Crookes & McKone, 2009).

This controversy remains unresolved. Several studies have returned to the postulate about the late maturity of face cognition. For example, Meinhardt-Injac, Persike, and Meinhardt (2014) have shown that although object perception by 14-to-16-year-old adolescents is on the same level as that of adults, face perception in this age group is not completely mature. To sum up, the trajectory of qualitative changes in the development of face cognition remains unclear; this path leads to other open questions — about the trajectory of quantitative changes in the development of face cognition and about factors that might influence this process.

Early versus late maturity of quantitative development. This controversy is based on the one about the qualitative development of face cognition and includes the same phases of changes of views on this question. In the classic studies of Carey and Diamond (1977) within the framework of the encoding-switch hypothesis but also in more recent studies (for example, Bruce et al., 2000), the trajectory of the quantitative development of face cognition was viewed as a linear increase with a slight decline at early puberty.

An alternative position starts from the theory of general development and postulates that 4-to-5-year-old children can already show as high a level of performance as adults if the procedure is organized in such a way that other cognitive functions are included in the decision process for the task. For example, Mondloch and colleagues (Mondloch, Dobson, Parsons, & Maurer, 2004; Mondloch, Le Grand, & Maurer 2002) found faster development in face-discrimination tasks that used a sequential presentation of faces; this result may be explained by the larger contribution of general memory. Based on the idea of Betts, Mckay, Maruff, and Anderson (2006) that psychometric-task performance in young children is characterized by

a lack of sustained attention, Lundy, Jackson, and Haaf (2001) used stimuli with a larger size to better focus the children's attention. Indeed, in children, this procedure diminished the "paraphernalia-effect", the obstruction of face memory by irrelevant details like wearing a hat.

In order to decide between these positions, it is important to return to the first controversy by finding the trajectory of the qualitative development of face cognition and to clarify the question about the specificity of the development of this process.

Nature versus nurture. As mentioned above, in the framework of the classic encoding-switch hypothesis, Carey and Diamond (1977) noted that the maturity of face cognition in adolescence is highly related to social experiences and high motivation to communicate as adolescents try to find new friends. Further research on the development of face cognition with different designs and different age groups of children led to the position that face cognition is congenital and genetically determined. This position is supported by studies with babies, psychogenetic studies, studies about congenital prosopagnosia, and comparative studies with monkeys (McKone, Crookes, Jeffery, & Dilks, 2012).

Even though genetics has an important role in the normal development of face cognition, experience also makes contributions to this development. Le Grand, Mondloch, Maurer, and Brent (2004) found that, even after effective treatment, patients with a bilateral congenital cataract, who therefore were deprived of structured visual input during the first months of life, may continue to have difficulties when they have to compare faces. Many studies by Gauthier showed the importance of experience for the performance of tasks with visual stimuli and also in face tasks (Gauthier et al., 2014). Another argument in favor of experience is the decrease of the other-race effect (difficulties in recognizing the faces of people of other ethnicities) with increasing experiences with people of the corresponding ethnicity (Tanaka, Kiefer, & Bukach, 2004). Finally, Sommer, Hildebrandt, Kunina-Habenicht, Schacht, and Wilhelm (2013) have shown that high social activity is meaningful for the normal functioning of face memory until old age.

In addition, both genetic factors and social experience are imperative for the normal and healthy development of face cognition.

Cross-cultural aspects of face cognition

Other-ethnicity effects in face-processing efficiency

Cross-cultural communication is becoming increasingly common and frequent. Face perception is usually the first way for people to get information from each other. Although most facial information is universal, there are also some cultural and ethnic differences that lead to differences in processing faces of one's own ethnicity and other-ethnic faces. Such a phenomenon was first pointed out by Feingold (1914), who revealed the tendency of people to more easily mix/confuse persons with other ethnicity than persons of their own ethnicity. Since then, many researchers have conducted studies on this topic. Some different terms were used to describe this mass of phenomena — for example, other-race effect, own-race bias, cross-race effect, own-race effect. Some authors use the word *ethnicity* or *culture*

instead of the word *race*. And there are more general terms — for example, *in-group effect* and *out-group effect*. Here we adopt the term *other-ethnicity effect*. The other-ethnicity effects revealed in previous studies can be grouped into two styles. One style is presented as the difference between face-processing efficiency when looking at the faces of people of one's own ethnicity and versus looking at the faces of people of other ethnicities; the other style is the cognitive bias in face processing.

In studying processing efficiency, the indices of response time and accuracy are usually taken as the dependent variables. Both advantages and disadvantages of other-ethnicity face processing have been reported; they are modulated by the task. In a face-recognition task (Meissner & Brigham, 2001) people are usually better at processing faces of their own ethnicity than faces of other ethnicities; this is the other-ethnicity disadvantage. However, when the task is to classify the ethnicity of faces, people are usually quicker to categorize other-ethnicity faces (Caldara, Rossion, Bovet, & Hauert, 2004; Levin, 1996, 2000); this is the other-ethnicity advantage. And there is a negative correlation in response time between the own-ethnicity advantage in face recognition and the other-ethnicity advantage in ethnicity-based categorization (Ge et al., 2009).

For the paradoxical phenomena of the other-ethnicity effects, the Categorization-Individuation Model (CIM) (Hugenberg, Young, Bernstein, & Sacco, 2010) provides a good explanation. This model indicates two different types of face processing. Categorization refers to the process of classifying examples into a group along shared dimensions, and identity refers to discrimination among category examples. The CIM suggests that the other-ethnicity effect results from the asymmetric experience and motivation of own-ethnicity and other-ethnicity faces in categorizing or individualizing. The CIM postulates a tendency to selectively identify or diagnose characteristics (for example, to configure information) among own-ethnicity faces (individuation) but to attend to category-diagnostic features (for example, skin tone) in other-ethnicity faces (categorization). Most perceivers have extensive experience in individuation with own-ethnicity faces but not necessarily with faces from another ethnicity. Therefore, if the task is to categorize the ethnicity of stimuli, it is suitable for other-ethnicity face processing, whereas recognition tasks lead to own-ethnicity advantages.

The CIM also admits that, in some cases, perceivers are motivated to process more individuation information in the face; such processing will overcome the basic tendency to categorize other-ethnicity faces. Emotion in facial expression might change the observer's motivation to process faces. For example, a study reported that the other-ethnicity disadvantage disappears when the face is angry; such mechanisms allow differentiation between out-group members to identify those who pose the greatest threat (Ackerman et al., 2006) When the task is to directly categorize the emotion of facial expression, the other-ethnicity effect is modulated by the type of emotion expression. In a review, Elfenbein and Ambady (2002) concluded that the other-ethnicity disadvantage is weakest — that is, agreement is best — for happiness and anger. However, this conclusion is not consistent if we carefully compare the previous studies. The amount of other-ethnicity effect on an emotional expression depends not only on the characteristic of this expression per se but also on the characteristics of the other expressions presented in the

experiment. Therefore, the results reasonably change among previous studies with different settings.

The other-ethnicity effect in facial-expression recognition is also modulated by the intensity of the expression. For example, in a study by Zhang, Parmley, Wan, and Cavanagh (2015) American and Chinese participants classified angry, sad, and happy expressions of Caucasian and Chinese face stimuli at subtle-, low-, and moderate-intensity levels. Other-ethnicity effects were present only for expressions of anger at low and moderate intensity, and for sadness expressed at moderate intensity.

However, a study (Johnson & Fredrickson, 2005) revealed that positive emotion elicited by unrelated videos also reduces the own-ethnicity advantage in facial recognition. The authors explained that possible mechanisms might include improvements in holistic processing and promotion of a common in-group identity because of positive emotions.

Other-ethnicity effects in face-processing bias

In studies of other-ethnicity effects, besides having the reaction time and the accuracy as the behavior-dependent variables, qualitative and quantitative evaluation has also been used. With evaluation tasks, the other-ethnicity effects might present as cognitive bias — that is, people might tend to give a special evaluation to the other-ethnicity faces in contrast to their own. We refer to this as the other-ethnicity effect in face-processing bias. Such bias could present in evaluating characteristics of other-ethnicity face stimuli, as well as in people's feeling for and attitude toward the faces.

This aspect of other-ethnicity effects has not been studied as much as the other-ethnicity effects in face-processing efficiency. For example, Russell (1994) and Elfenbein and Ambady (2002) suggested examination of cultural variability not only for specific, discrete emotions but also for broad dimensions of affect. However, Russell (1991) also thought that the broad dimensions of affect (for example, arousal and valence) might be easier to identify and interpret across cultures. There are, in fact, quantitative differences for rating emotional stimuli along these dimensions across cultures as well. For example, facial expressions of European posers were rated lower in intensity by Asian than by European participants (Ekman et al., 1987). In a study with Japanese and Americans as observers and posers, the American observers gave higher intensity ratings than did the Japanese observers to all emotions regardless of the poser's ethnicity, except for disgust posed by Japanese (Matsumoto & Ekman, 1989). Although these studies reported some cultural specificity in the ratings of emotion intensity, these specificities were not bi-directionally present across cultures, precluding more general conclusions about other-ethnicity effects in emotion-intensity ratings.

Furthermore, people might give different explanations for the same facial expression because of the variability of cultures. For example, although the reaction time and accuracy of identifying the smile expression bears little other-ethnicity effect (Elfenbein & Ambady, 2002), and it is assumed to be culturally universal that smiling individuals are usually perceived more favorably than nonsmiling ones — they are judged as happier, more attractive, competent, and friendly — a

study showed that the perception of smiling individuals is culturally diversified and that, in some cultures, this generally positive nonverbal signal may have negative associations (Krys et al., 2015).

Conclusion

Face cognition is a rather contradictory area of investigation. In future studies it will be important to clarify questions about the qualitative development of face cognition and about qualitative characteristics like holistic processing. From the developmental point, it is still not clear at which age this characteristic ability reaches full maturity. Cultural factors are also an important aspect influencing the functions of face cognition. Finally, research on the brain mechanisms of face processing will continue to be an important domain for our understanding of general issues in social neuroscience and social psychology.

Taken together, data from neurobiological, psychological, and cross-cultural research demonstrate the close connections of face processing with special organized brain activity, the individual nature of a person, and the cultural specificity of social relations. In this combination of nature and nurture factors psychologists tend to consider experience as the leading driving force for the formation of face cognition. But an increasing number of behavioral and neurophysiological findings challenge this view and argue that the role of experience in the development of the mechanisms of face processing has been overestimated. The emerging picture is that the mechanisms supporting face cognition mature at the earliest ages (3–5 years of age and, even, infancy) and are driven by everyday social contacts and also by innate brain factors. Thus, to fully understand the mechanisms of face processing, the "approach from mind" and the "approach from brain" should complement each other. Such a complex psychophysiological approach will be implemented in the framework of the wide-scale research on interethnic relations in multinational and multicultural Russia.

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Neurophysiological correlates of artistic image creation by representatives of artistic professions

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The steadily increasing demand for artistic professions brings to the fore the task of studying the phenomenon of art by researching the unique capacity of the human brain to create works of art in different spheres of creative activity. So far, only a few studies have investigated creativity-related brain activity in representatives of the creative professions. The aim of the empirical research was to study the neurophysiological correlates of artistic image creation by representatives of the artistic professions. The participants were 60 right-handed females aged 23-27, divided into three groups—**artists** (23 people), **actors** (17 people), and **specialists** who do not work in an artistic field (20 people). The mono-typing technique was used to model the creative artistic process. EEG signals were recorded in a resting state, and during four stages of the creation of an artistic image (viewing of monotypes, frustration, image creation, and thinking over the details) from 21 electrodes set on the scalp according to the International 10-20 System. We analyzed EEG coherence for each functional trial at theta (4.00–8.00 Hz), alpha1 (8.00–10.5 Hz), alpha2 (10.5–13.00 Hz), and beta (13.00– 35.00 Hz) frequency bands. For statistical analysis, we used MANOVA and post hoc analysis. We found that the neurophysiological correlates of creating an artistic image are different at different stages of the creative process, and have different features for **artists** and **actors**. The **actors** primarily show dominance of right hemisphere activity, while close interaction of the hemispheres distinguishes the brains of the **artists**. The differences revealed in brain cortex functioning when **artists** or **actors** create an artistic image reflect different strategies of imaginative creative work by representatives of these professions.

Keywords: brain hemispheres, cortex, EEG, coherence, frequency band, art, artistic image

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Introduction

Art is an essential part of human life, a specific area of human activity aimed at cognition of objective reality. Artistic imagery is a way of exploring reality. An artistic image is a merging of immediate data, sensual characteristics, and the idea that is used to convey the artist's general attitude.

Artistic, engineering, musical, and dance activities, as well as performance, require the creation of an artistic image, represented by the different forms of art (picture, dance, piece of music). Each of these professional activities has its structural peculiarities, its means of creating and artistically realizing the valuable contents of the image, as well as its methods of teaching professionals. Hence, the **artist's** professionalism is rooted in a special competence predetermining the level of mastery of composition based on the development of compositional thinking and practical graphic activity. On the other hand, the creative work of **actors** is expressed through forming scenic images, often employing improvisation that adds freshness and spontaneity to the performance.

The steadily increasing demand for the artistic professions brings to the fore the task of studying the phenomenon of art by researching the unique capacity of the human brain to create works of art in different spheres of creative activity. The neuroscientific study of creative activity helps us unterstand how the brain works during the generation of creative ideas. The study of the development of higher mental functions led Vygotsky (1934/2005) to the conclusion that the brain's role in its own organization must change in each individual's development. Taking into account that the creative process is a complex cognitive activity, we are guided by Vygotsky's idea about the connection between the development of mental functions and change in the organization of the brain.

Understanding the brain's mechanisms during creative processes will permit us to carry out psychophysiological diagnostics aimed at vocational guidance; forecast success in training artists; and select and implement programs of potential creative development.

Existing studies of the neurophysiological correlates of artistic creativity are promising. But so far, only a few studies have investigated creativity-related brain activity (like improvising music, composing an artwork) in **artists** (Bhattacharya & Petsche, 2005; Dikiy, Dikaja, & Karpova, 2016; Kowatari, Lee, Yamamura, Nagamori, Levy, Yamane, & Yamamoto, 2009), musicians (Dikaya & Skirtach, 2015; Dikiy, Dikaya, & Skirtach, 2014; Gibson, Folley, & Park, 2009; Limb & Braun, 2008; Liu, Chow, Xu, Erkkinen, Swett, Eagle, & Braun, 2012; Pereda, Rahman, & Bhattacharya, 2014; Pinho, de Manzano, Fransson, Eriksson, & Ullén, 2014; Villarreal , Cerquetti, Caruso, Aranguren, Gerschcovich, Frega, & Leiguarda, 2013), **actors** (Rodionov, 2013; Starchenko, Kireev, & Medvedev, 2014); and **dancers** (Dikaya, Naumova, & Naumov, 2015; Fink, Graif, & Neubauer, 2009).

However, the question of the neurophysiological correlates of professional creative activity has been left unanswered, despite the growth of scientific interest in studying the brain functioning of representatives of the artistic professions. Thus, research from recent years reveals the contradictory character of contemporary scientists' ideas about the role of the brain's hemispheres in connection with creative

work. The results of some research state that the right hemisphere dominates in the process of creative activity (Asari, Konishi, Jimura, Chikazoe, Nakamura, & Miyashita, 2008; Bhattacharya & Petsche, 2005; Jung, Mead, Carrasco, & Flores, 2013; Jung-Beeman, Bowden, Haberman, Frymiare, Arambel-Liu, Greenblatt, & Kounios, 2004; Kounios & Beeman, 2014), while others show left hemisphere dominance (Dikiy, Dikaya, & Skirtach, 2014; Gonen-Yaacovi, de Souza, Levy, Urbanski, Josse, & Volle, 2013; Jin, Kwon, Jeong, Kwon, & Shin, 2006). The scientific literature also contains studies that show close inter-hemisphere integration (Јаиљовец, 2000; Mayseless & Shamay-Tsoory, 2015; Razumnikova & Yashanina, 2014), and independent functioning of the brain hemispheres while the person is performing creative work (Bechtereva & Nagornova, 2007; Dikaya, Dikiy, Karpova, & Lavreshina, 2016; Fink & Benedek, 2014).

The likely answer concerning the cerebral hemispheres is that both are functional in creativity, but each hemisphere contributes a different facet, still little understood, to the creativity process (Zaidel, 2014).

Questions about the level of cortical activation when a person is performing creative tasks, and about the role of different regions of the brain in the implementation of creativity, remain open as well.

The question of the source of the original ideas in artistic work is a complex one that researchers would like understand. Altogether, the latest studies suggest that creativity cannot be localized in one or a few regions of the brain; rather they show that when humans are engaged in any sort of creative activity, a multitude of regions of the brain are activated (Dietrich & Kanso, 2010; Dikaya & Dikiy, 2015; Starchenko et al., 2014; Wiggins & Bhattacharya, 2014).

We can conclude that there is significant heterogeneity in the results of studies of brain functioning during creative work. The contradictory data received by researchers can be explained by the fact that studies of the brain's organization during the creative process are carried out without regard to its basic stages. There is a deficiency of research aimed at studying the dynamics of brain activity at different stages of creative process, which are: 1) Preparation (defining a problem, gathering information, attempting a solution); 2) Incubation (the unconscious process of the "maturing of the decision"); 3) the Illumination or Insight or "Aha" experience (a creative idea flashes into sight); and 4) Verification (checking the adequacy of the solution).

A promising approach involves EEG research of the brain's cortex's functional organization in representatives of the different artistic professions on a task close to actual professional life. We believe that a mono-typing technique such as artistic improvisation based on a shapeless smudge can be a good way to model the real creative process.

Method

The aim, hypotheses, and participants

The aim of our empirical research was to study the neurophysiological correlates of artistic image creation by representatives of the artistic professions.

The following assumptions were set forward as hypotheses:

- The main stages of artistic image creation can be reflected in the dynamics of the brain activity of representatives of different artistic professions;
- The dynamics of brain activity at different stages of artistic image creation can be predetermined by the type of professional activity (art sphere) that the representatives are engaged in (**artists**, **actors**).

Sixty right-handed female human subjects aged 23-27 took part in the research. They were divided into three groups depending upon their profession: **artists** (23 people), **actors** (17 people), and **specialists** who do not work in an artistic field (20 people). All participants were right-handed at birth; none were "corrected" right-handers. Handedness was assessed using the Questionnaire of Hand Preference (Annett, 1970).

All the artistic professionals had higher or vocational education and 2-3 years of work experience in their professions. Taking these indicators into account provides the basis for assuming the subjects had a definite level of professional development in carrying out creative work, and for avoiding the possibility of professional deformation influencing the subjects' personalities.

The participants were briefed on the research procedure in advance, and confirmed their agreement to take part in it.

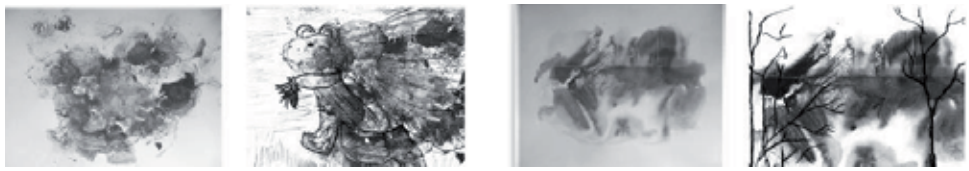
Experimental design

Mono-typing technique was used to model the creative artistic process. Mono-typing is an improvisation based on a shapeless smudge. The technique presupposes the random imprinting of paint on paper. As a result, a composition is created out of shapeless imprints that do not convey anything in particular, but stimulate the imagination (Bondareva, 2009). The advantage of this method is that the person using it doesn't adjust to the task; on the contrary, the task is transformed into a means of self-expression. Mono-typing offers an opportunity to create something new independently, and can evoke an internal drive to trigger the artistic creative process, provide for solving the task by means of insight, and consequently provide an opportunity to model a truly creative process.

In the course of the empirical research, the subjects were offered eight monotypes. To provide a choice of means suitable to depicting the conceived composition, the participants were offered various artistic materials (pastels, watercolors, gouache, colored pencils, etc.).

The research procedure presupposed that, according to the preparatory guidance, the participants should create an artistic image in their imagination based on one of the given monotypes, then think over the details, and find expressive means to convey the picture they conceived. The time frame for the creation of an artistic image was not limited. Figure 1 presents examples of the monotypes and some artistic images based on them.

We used the electroencephalography method (EEG) of measurement. We registered the EEG results with the help of the Elitnaya-M version of the Encephalan device, which was produced by Medicom in Taganrog, Russia.



The monotype | The finished composition | The monotype | The finished composition

Figure 1. Examples of monotypes and finished compositions based on these artistic images

The EEG signals were recorded while the subjects were in a resting state with their eyes open, and during the four stages of creating an artistic image (viewing the monotypes, frustration, image creation, and thinking over the details). There were 21 scalp electrodes (Fpz, Fz, Cz, Pz, Oz, Fp1, Fp2, F3, F4, F7, F8, C3, C4, T3, T4, T5, T6, P3, P4, O1, O2), set according to a monopolar scheme with ipsilateral ear referents according to the International 10-20 System. Since the main part of the research was carried out when the participants' eyes were open, a resting state with eyes open was used as the default state.

The stages of creating an artistic image were chosen by us to correspond to the stages of the creative process. The stage "Viewing of monotypes" corresponds to Preparation stage (definition of a problem, gathering of information, first attempts at solving the problem). At the Frustration stage, a person experiences negative emotions due to his/her inability to find a solution. The stage of "Image creation" corresponds to Insight (the sudden finding of a solution). And the stage of "Thinking over the details" corresponds to the stage of Verification (the creative idea is subjected to evaluation).

Only artifactless EEG samples, 10 seconds each, were analyzed. We analyzed EEG coherence for each functional trial at the following frequency bands: theta (4.00–8.00 Hz), alpha1 (8.00–10.5 Hz), alpha2 (10.5–13.00 Hz), and beta (13.00–35.00 Hz).

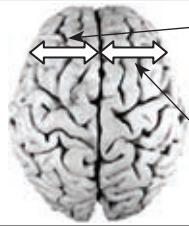
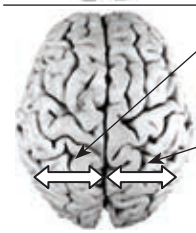
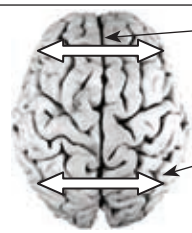
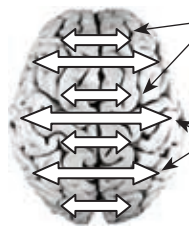
Coherent connections between pairs of electrodes for each frequency band were divided into the following groups: short-distance intra-hemispheric (4), long-distance intra-hemispheric (2), interhemispheric in the anterior and posterior cortex regions (2), cross-hemispheric (diagonal) (2), and interhemispheric symmetrical (between symmetrical pairs of leads) (2). *Table 1* presents twelve kinds of analyzed coherent connections.

Average values were calculated for each kind of connection from each frequency band. The coherent connection was considered strong if its value was 0.7 or higher.

Statistical data processing

For statistical analysis, we used descriptive statistics and 3-way MANOVA (Multivariate analysis of variance). A comparative post hoc analysis according to the Fisher criteria was used as well. The processing was conducted with the help of STATISTICA 12.0 computer software.

Table 1. The kinds of coherent connections analyzed

	Kinds of coherent connections			Corresponding pairs of leads
Iintrahemispheric	Short-distance intrahemispheric connections		1 — in left anterior cortex regions	Fp1–F3; Fp1–F7; Fp1–T3; F3–F7; F3–T3; F7–T3
			2 — in right anterior cortex regions	Fp2–F4; Fp2–F8; Fp2–T4; F4–F8; F4–T4; F8–T4
			3 — in left posterior cortex regions	O1-P3; O1-T5; O1-C3; P3-C3; P3-T5; T5-C3
			4 — in right posterior cortex regions	O2-P4; O2-T6; O2-C4; P4-C4; P4-T6; T6-C4
	Long-distance intrahemispheric connections		5 — between left anterior and posterior cortex regions	Fp1–O1; Fp1–P3; Fp1–T5; F7–O1; F7–T5; F7–P3; F3–T5; F3–P3; F3–O1
			6 — between right anterior and posterior cortex regions	Fp2–O2; Fp2–P4; Fp2–T6; F8–O2; F8–T6; F8–P4; F4– T6; F4–P4; F4–O2
Interhemispheric	Interhemispheric connections in anterior and posterior cortex regions		7 — in anterior cortex regions	F_p1–F8; F_p1–T4; F_p1–F4; F_p2–F7; F_p2–T3; F_p2–F3; F7–F4; F7–T4; F8–F3; F8–T3; F3–T4; F4–T3
			8 — in posterior cortex regions	O1–T6;O1–P4; O2–T5; O2–P3; P4–T5; P3–T6
	Cross-hemispheric connections		9 — between left anterior and right posterior cortex regions	F_p1–O2; F_p1–T6; F_p1–P4; F7–O2; F7–T6; F7–P4; F3–O2; F3–T6; F3–P4
			10 — between right anterior and left posterior cortex regions	F_p2–O1; F_p2–T5; F_p2–P3; F8–O1; F8–T5; F8–P3; F4–O1; F4–T5; F4–P3
	Interhemispheric symmetrical connections		11 — short-distance between symmetrical leads	F_p1– F_p2; F3–F4; C3-C4; P3-P4; O1-O2
			12 — long-distance between symmetrical leads	F7–F8; T3-T4; T5-T6

Results

Results of the descriptive analysis

A descriptive analysis of the average values of the coherence coefficients was carried out to determine the degree of cohesion of neural ensembles of various cerebral cortex regions in the representatives of the different professional groups at the different stages of the creative process. The results of the descriptive analysis for each frequency band are shown in *Figures 2-5*.

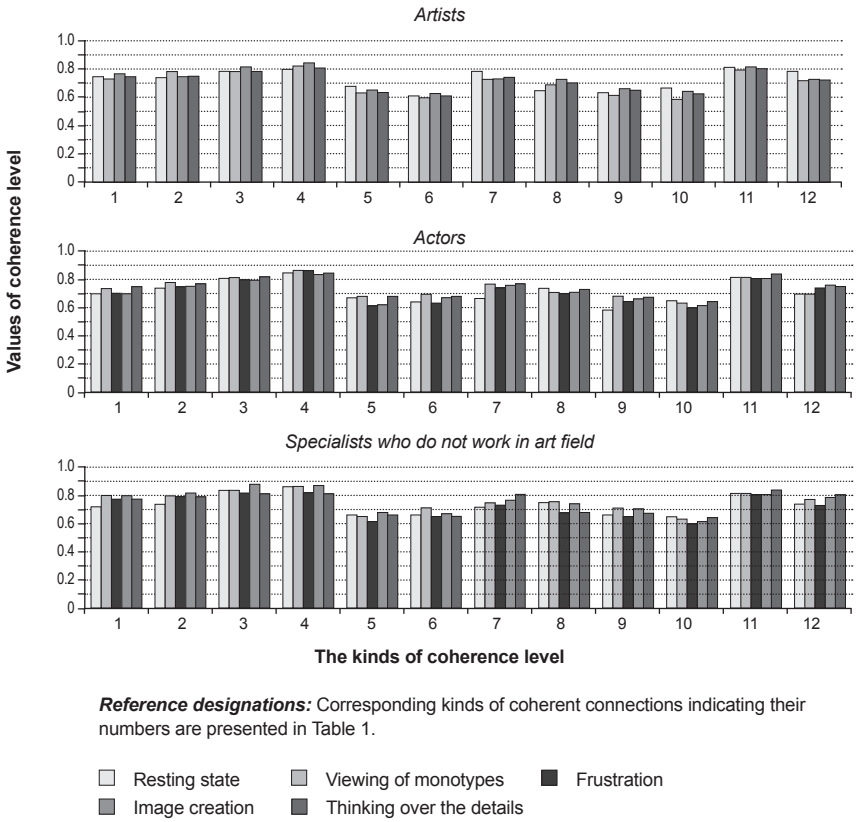


Figure 2. Average values of the analyzed coherent connections in the cortex of the research participants at different stages of artistic image creation at theta band

So, at the stage of viewing the monotypes, strong coherent connections are expressed in **artists**' right anterior cortex regions, between the left anterior and posterior cortex regions, between the anterior left and right cortex regions, and between symmetrical leads of both hemispheres at theta band; between the posterior left and right cortex regions at theta and alpha1 bands; in the left anterior cortex regions at alpha2 band; in the right anterior cortex regions as well between the right anterior and posterior cortex regions at beta band (*Fig. 2-5*).

At the stage of image creation, high values of coherence were found in the **artists'** anterior cortex regions of both hemispheres, and in the posterior and anterior cortex regions between brain hemispheres at theta band; in the posterior and ante-

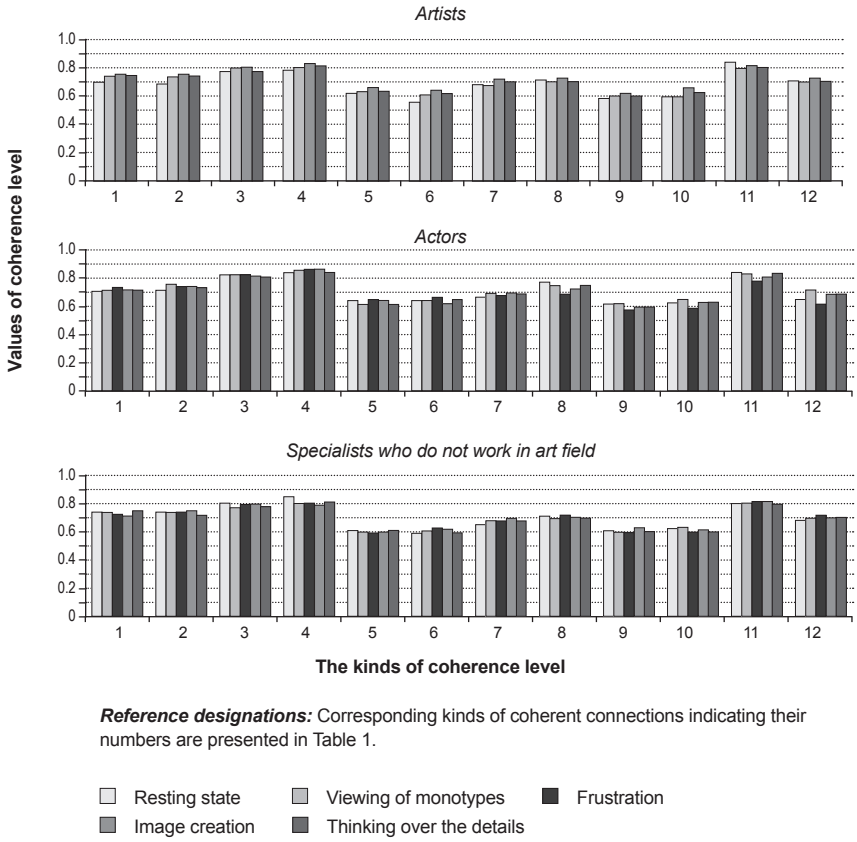


Figure 3. Average values of the analyzed coherent connections in the cortex of the research participants at different stages of artistic image creation at alpha1 band

rior cortex regions between hemispheres and between long-distance symmetrical leads of both hemispheres at alpha1 band; in the left anterior cortex regions at alpha2 band, and in the anterior cortex regions of both hemispheres at beta band.

At the stage of thinking over the details, high values of coherence were found in the **artists'** anterior cortex regions of both hemispheres, as well in the anterior and posterior cortex regions between brain hemispheres at theta band; in the posterior cortex regions between hemispheres at alpha1 band; in the left anterior cortex regions at alpha2 and beta bands (*Fig. 2-5*).

Strong coherent connections are expressed in **actors** at the stage of the viewing of monotypes in their left anterior cortex regions, between the right anterior and posterior cortex regions, and in the posterior cortex regions between brain hemispheres at theta band; in the left anterior cortex regions at alpha1 and alpha2 bands; between the anterior and posterior cortex regions in both hemispheres, and in the posterior cortex regions between hemispheres at alpha2 band; in the left anterior cortex regions as well as between the anterior and posterior cortex regions in both hemispheres at beta band (*Fig. 2-5*).

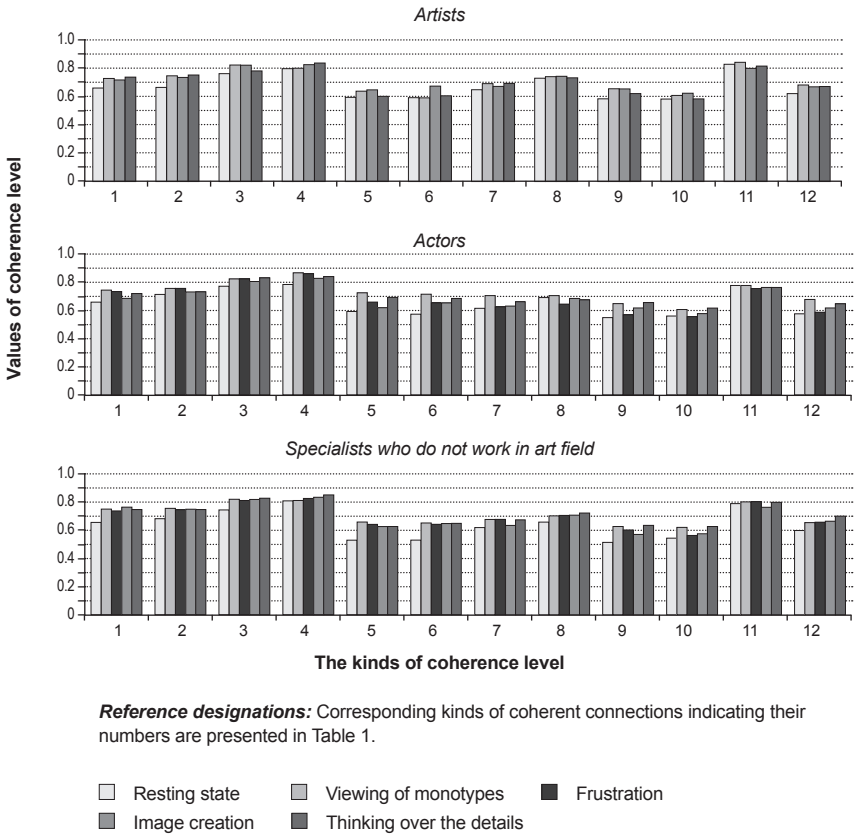


Figure 4. Average values of the analyzed coherent connections in the cortex of the research participants at different stages of artistic image creation at alpha2 band

At the stage of frustration, strong coherent connections are found in **actors** in the left anterior cortex regions at alpha1 band.

At the stage of image creation, the most expressive coherent connections in **actors** are located between the left and right posterior cortex regions at theta and alpha1 bands; in the left anterior cortex regions, and between the right anterior and posterior cortex regions at beta band.

At the stage of thinking over the details, high coherence values were found in **actors** between the anterior and posterior cortex regions of both hemispheres at theta band; between the posterior cortex regions of both hemispheres at alpha1 band; in the left anterior cortex regions at alpha2 band (*Fig. 2-5*).

The distribution of coherent connections in **specialists** who do not work in an artistic field, is the same as in **artists** and **actors**; only the power of the coherent links they have is higher.

So, the intra-hemispheric connections in the left and right posterior cortex regions, and interhemispheric symmetrical connections, especially in the anterior and posterior cortex regions, are dominant in these participants at all frequency bands.

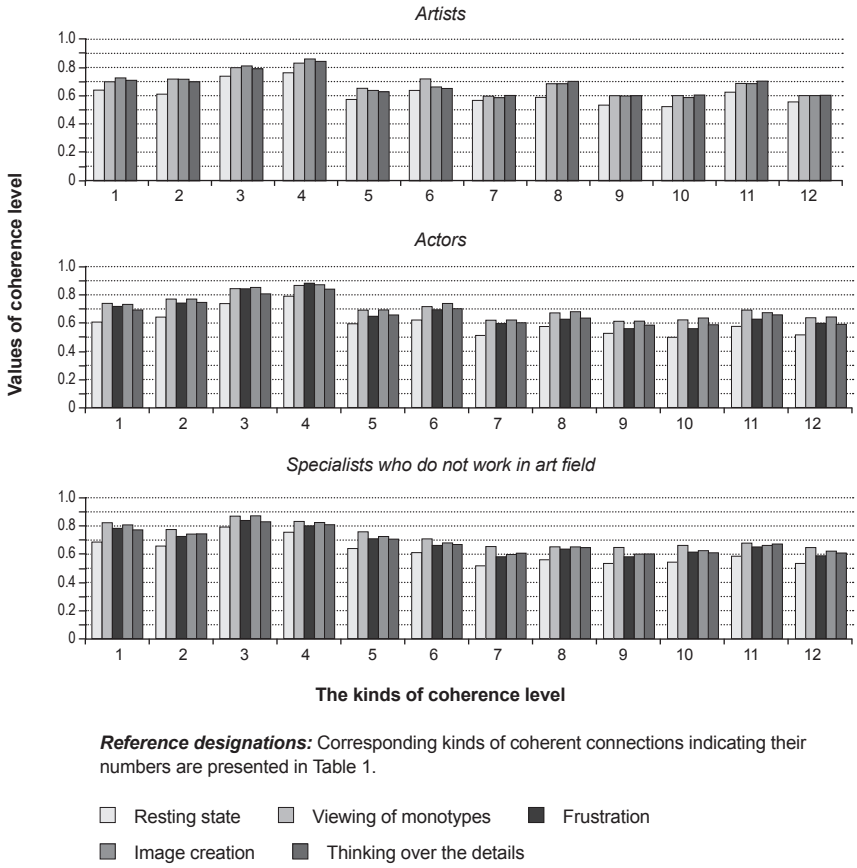


Figure 5. Average values of the analyzed coherent connections in the cortex of the research participants at different stages of artistic image creation at beta band

MANOVA results

We analyzed the frequency-specific effects of three factors: "GROUP"–1) **artists**, 2) **actors**, and 3) **specialists** who do not work in an artistic field; "TRIAL"–1) resting, 2) viewing of monotypes, 3) frustration, 4) image creation, and 5) thinking over the details; and "KIND OF COHERENT CONNECTION" (12).

As a result of the 3-way MANOVA, a number of frequency-specific effects of the factors GROUP, TRIAL, and KIND OF COHERENT CONNECTION, and their interactions in functional changes of EEG coherence, were revealed. The main effects of these factors' interaction were significant in changes of functional EEG coherence for each frequency band, but with different degrees of significance (F (4, 193) = 5.89, $p < .05$ for theta band; F (1,851) = 9.64, $p < .001$ for alpha1 band; F (1,488) = 8.4, $p < .001$ for alpha2 band; and F (3, 785) = 6.93, $p < .01$ for beta band). The effects of the interaction of GROUP × TRIAL × KIND OF COHERENT CONNECTION were expressed to the greatest extent because their influence leads to significant changes in EEG coherence in the greatest number of different areas of

the brain ($p < .05$). So we have carried out a comparative post hoc analysis (according to the Fisher criteria, $p < .05$) of values of EEG coherence in **artists**, **actors** and **specialists** not engaged in artistic sphere during different stages of artistic image creation.

The results of comparative post hoc analysis of values of EEG coherence in research participants during artistic image creation

As a result of comparative post hoc analysis, we revealed significant differences in the average values of coherence at the various stages of artistic image creation in the cortex of **artists**, **actors** and **specialists** who do not work in an artistic field (Tables 2–4).

Table 2. Average values of the coherent connections that are significantly changed at various stages of artistic image creation in the cortex of **artists**

Frequency bands	Kinds of coherent connections	Stages of an artistic image creation	Overage values of coherent connections	Significance levels
Theta	7	Resting state Viewing of monotypes	0.82692±0.15 0.73985±0.11	$p < .05$
	12	Resting state Viewing of monotypes	0.82290±0.14 0.72993±0.12	$p < .05$
	7	Resting state Image creation	0.82692±0.15 0.74310±0.11	$p < .05$
	8	Resting state Image creation	0.68041±0.16 0.74066±0.1	$p < .05$
	7	Resting state Thinking over the details	0.82692±0.15 0.75111±0.16	$p < .05$
Alpha2	11	Resting state Image creation	0.83881±0.1 0.78444±0.11	$p < .05$
Beta	2	Resting state Viewing of monotypes	0.63535±0.12 0.71628±0.09	$p < .01$
	4	Resting state Viewing of monotypes	0.77892±0.12 0.83244±0.09	$p < .05$
	6	Resting state Viewing of monotypes	0.57514±0.07 0.69066±0.09	$p < .0001$
	1	Resting state Image creation	0.65876±0.12 0.72086±0.09	$p < .05$
	4	Resting state Image creation	0.77892±0.12 0.85520±0.09	$p < .01$

Note. Corresponding kinds of coherent connections indicating their numbers are presented in Table 1.

Table 3. Average values of the coherent connections that are significantly changed at various stages of artistic image creation in the cortex of **actors**

Frequency bands	Kinds of coherent connections	Stages of an artistic image creation	Overage values of coherent connections	Significance levels
Alpha1	8	Resting state Frustration	0.78712±0.07 0.68833±0.08	$p < .01$
Alpha2	4	Resting state Viewing of monotypes	0.60139±0.12 0.71054±0.14	$p < .01$
	3	Resting state Viewing of monotypes	0.62242±0.14 0.71600±0.1	$p < .01$
	6	Resting state Frustration	0.66756±0.13 0.74703±0.07	$p < .05$
	8	Resting state Frustration	0.72367±0.08 0.64081±0.08	$p < .05$
	5	Viewing of monotypes Frustration	0.74032±0.13 0.64446±0.14	$p < .01$
	4	Resting state Thinking over the details	0.60139±0.12 0.67783±0.09	$p < .05$
	3	Viewing of monotypes Image creation	0.71600±0.1 0.61692±0.1	$p < .01$
	5	Frustration Thinking over the details	0.64446±0.14 0.71722±0.1	$p < .05$
Beta	2	Resting state Viewing of monotypes	0.67219±0.12 0.76660±0.1	$p < .001$
	1	Resting state Viewing of monotypes	0.63708±0.1 0.73779±0.1	$p < .001$
	4	Resting state Viewing of monotypes	0.80950±0.11 0.86891±0.08	$p < .05$
	3	Resting state Viewing of monotypes	0.76855±0.13 0.84683±0.09	$p < .01$
	6	Resting state Viewing of monotypes	0.63236±0.11 0.72063±0.1	$p < .01$
	5	Resting state Viewing of monotypes	0.62956±0.09 0.68766±0.13	$p < .05$
	2	Resting state Frustration	0.67219±0.12 0.74095±0.09	$p < .05$
	1	Resting state Frustration	0.63708±0.1 0.71753±0.08	$p < .01$
	4	Resting state Frustration	0.80950±0.11 0.87904±0.08	$p < .05$

Frequency bands	Kinds of coherent connections	Stages of an artistic image creation	Overage values of coherent connections	Significance levels
Beta	3	Resting state Frustration	0.76855±0.13 0.84491±0.11	$p < .01$
	6	Resting state Frustration	0.63236±0.11 0.69787±0.07	$p < .05$
	2	Resting state Image creation	0.67219±0.12 0.77254±0.08	$p < .001$
	1	Resting state Image creation	0.63708±0.1 0.73326±0.1	$p < .001$
	4	Resting state Image creation	0.80950±0.11 0.87290±0.09	$p < .05$
	3	Resting state Image creation	0.76855±0.13 0.84887±0.1	$p < .01$
	6	Resting state Image creation	0.63236±0.11 0.74004±0.07	$p < .001$
	5	Resting state Image creation	0.62956±0.09 0.72607±0.11	$p < .001$
	6	Resting state Thinking over the details	0.63236±0.11 0.69905±0.09	$p < .05$

Note. Corresponding kinds of coherent connections indicating their numbers are presented in Table 1.

Table 4. Average values of the coherent connections that are significantly changed at the stages of artistic image creation in the cortex of **specialists** who do not work in an artistic field

Frequency bands	Kinds of coherent connections	Stages of an artistic image creation	Overage values of coherent connections	Significance levels
Theta	8	Resting state Frustration	0.77829±0.19 0.68147±0.11	$p < .05$
	9	Resting state Frustration	0.73860±0.15 0.65353±0.15	$p < .01$
	9	Viewing of monotypes Frustration	0.72056±0.13 0.65353±0.15	$p < .05$
	8	Resting state Thinking over the details	0.77829±0.19 0.67725±0.14	$p < .05$
Alpha2	1	Resting state Image creation	0.67920±0.15 0.75586±0.12	$p < .05$

Frequency bands	Kinds of coherent connections	Stages of an artistic image creation	Overage values of coherent connections	Significance levels
Beta	2	Resting state Viewing of monotypes	0.69006±0.08 0.77404±0.1	$p < .01$
	1	Resting state Viewing of monotypes	0.71441±0.1 0.82137±0.09	$p < .001$
	6	Resting state Viewing of monotypes	0.64222±0.06 0.71355±0.09	$p < .05$
	5	Resting state Viewing of monotypes	0.65368±0.11 0.76124±0.1	$p < .001$
	1	Resting state Frustration	0.71441±0.09 0.77976±0.1	$p < .05$
	1	Resting state Image creation	0.71441±0.09 0.80359±0.1	$p < .01$
	1	Resting state Thinking over the details	0.71441±0.09 0.77702±0.11	$p < .05$

Note. Corresponding kinds of coherent connections indicating their numbers are presented in Table 1.

The high values of intra- and interhemispheric coherence between certain brain regions were revealed in all research participants at theta band. In addition, the dynamics of their distribution varied at different stages of artistic image creation (Fig. 6).

A weakening of short-distance coherent links within the left hemisphere at theta band was observed at the stage of viewing of monotypes, compared to a resting state in representatives of artistic professions ($p < .05$). A decrease in interhemispheric connections was also revealed: **Artists** had less interhemispheric long-distance symmetrical connections; **actors** had less interhemispheric anterior, posterior and long-distance symmetrical connections ($p < .05$). In representatives of both creative groups, there were distinct short-distance connections in the right hemisphere at the stage of viewing of monotypes; **artists** also demonstrated interhemispheric anterior connections ($p < .05$) (Tables 2, 3).

Artists exhibit a strengthening of short-distance connections in the left hemisphere ($p < .05$) and posterior interhemispheric connections ($p < .01$) at theta band at the stage of image creation and thinking over the details of composition. The stage of image creation is characterized by an increased intensity of short-distance left hemisphere connections, and interhemispheric anterior and long-distance symmetrical connections in the **actors'** brains. Increased intensity of the coherence of interhemispheric posterior and short-distance symmetrical connections ($p < .05$) is typical for the stage of thinking over the details of composition (Tables 2, 3).

The EEG did not reveal any changes in the cortex's functional state in **specialists** who do not work in an artistic field, at theta band during the image creation process compared to the resting state; high values of intra- and interhemispheric coherence were observed during the whole course of the research study (Table 4).

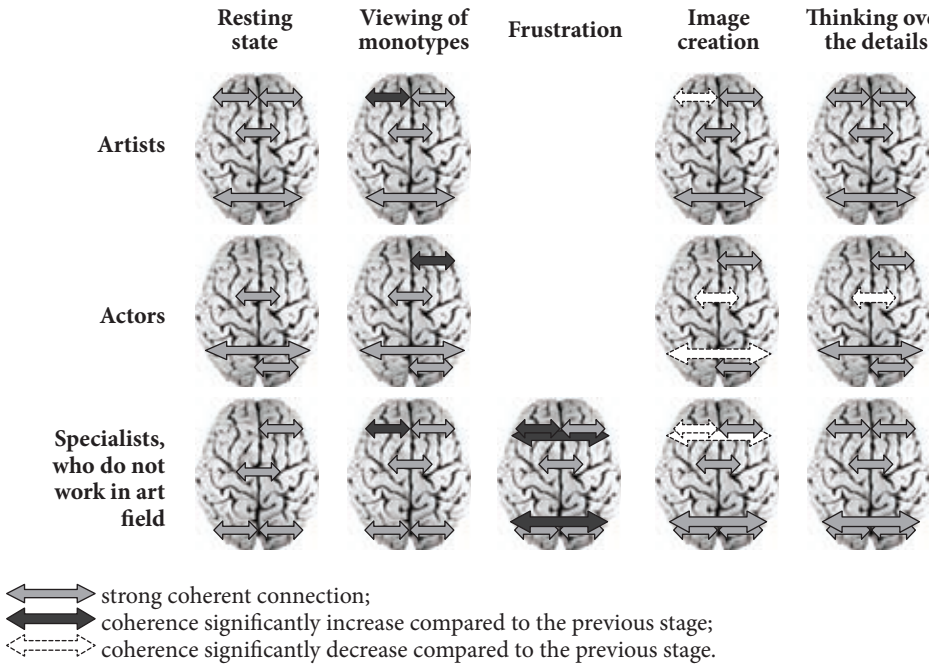


Figure 6. Significant differences in the strength of functional cortex connections at theta band in representatives of different professional groups at different stages of artistic image creation ($p < .05$)

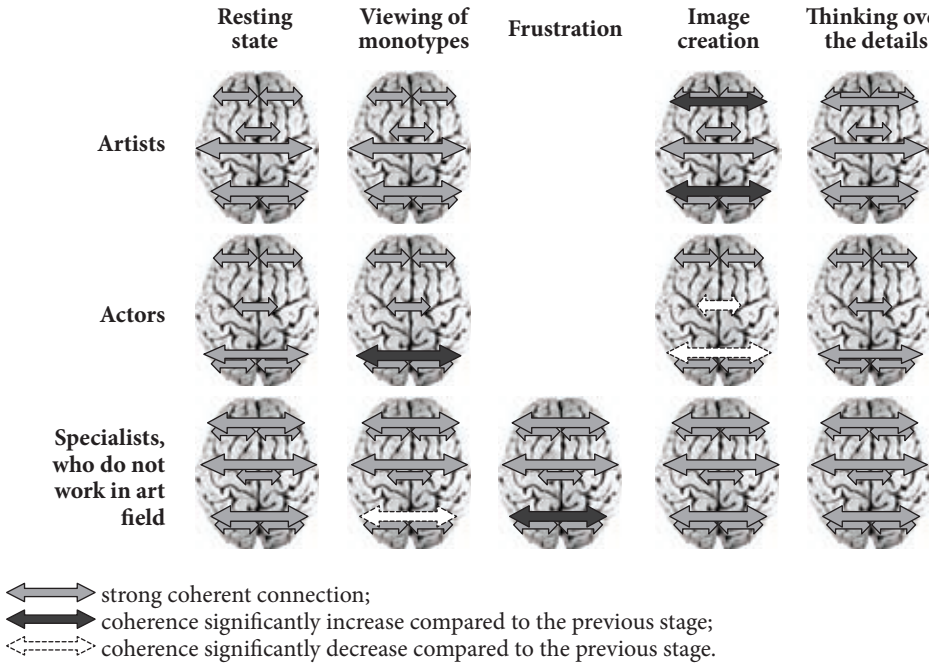


Figure 7. Significant differences in the strength of functional cortex connections at alpha1 band in representatives of different professional groups at different stages of artistic image creation ($p < .05$)

A high level of intra-hemispheric interaction in both hemispheres was identified at all stages of artistic image creation in all research participants at alpha1 band (*Fig.7).* Meanwhile, different stages of the creative process of representatives of each professional group are characterized by enhanced interhemispheric interaction in the posterior brain cortex at alpha1 band ($p < .01$): The **artists** have it at the stage of image creation, **actors** at the stage of viewing of monotypes; the **specialists** who do not work in an artistic field, demonstrate it at the stage of frustration (*Tables 2-4*). Increased intensity of coherence of the anterior interhemispheric connections is also observed in **artists'** brains at the stage of image creation ($p < .01$).

Analysis of the coherence at alpha2 band showed values of intra- and interhemispheric connections between certain brain cortex regions during artistic image creation that varied for the representatives of each professional group under study (*Fig. 8*). **Artists** have high values of coherence in short-distance left hemispheric connections when they are viewing monotypes; however, the significance of these values decreases at the stage of image creation ($p < .05$).

Low values of coherence in the anterior connections of the left hemisphere ($p < .05$) and high values in short-distance connections of the right hemisphere ($p < .01$) are inherent in the **actors'** brain throughout the creative process (*Table 3*).

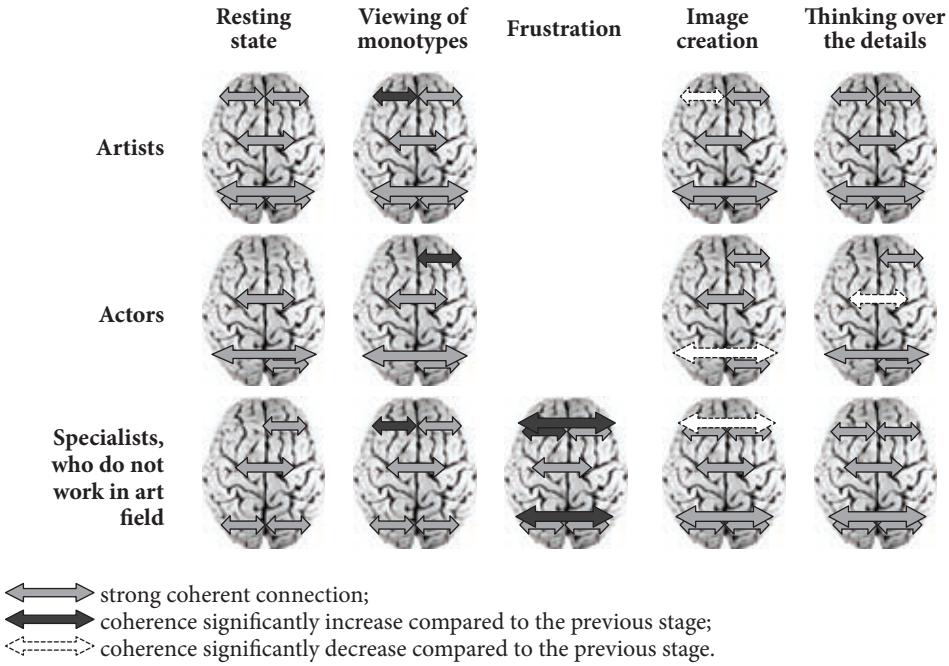


Figure 8. Significant differences in the strength of functional cortex connections at alpha2 band in representatives of different professional groups at different stages of artistic image creation ($p < .05$)

The **specialists** who do not work in an artistic field, have increased short-distance anterior connections in the left hemisphere at the stage of viewing of monotypes, compared with the resting state, and increased intensity of interhemispheric

anterior and posterior connections at the stage of frustration ($p < .05$). The stages of image creation and thinking over the details are characterized by a decreased intensity of short-distance anterior left- and interhemispheric connections ($p < .05$) (*Table 4*).

At beta band, the dynamics of the distribution of coherence connections is similar among subjects in all groups. (*Fig. 9*). At all stages of artistic image creation, a high level of intra-hemispheric interaction in both hemispheres ($p < .01$) and a low level of interhemispheric interaction ($p < .01$) were revealed. This result can serve as a proof of independent and parallel functioning of brain hemispheres, and separate processing of graphic information (Behtereva & Nagornova, 2007; Dikaya et al., 2016).

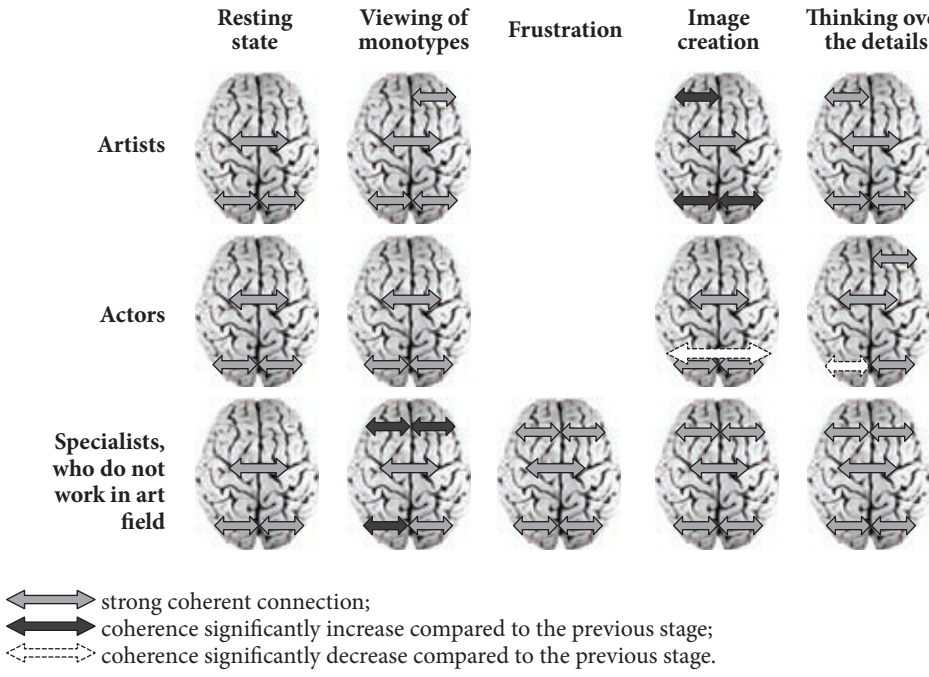


Figure 9. Significant differences in the strength of the functional cortex connections at beta band in representatives of different professional groups at different stages of artistic image creation ($p < .05$)

As a result of the research, neurophysiological correlates of artistic image creation were studied for representatives of different artistic professions (**artists**, **actors**) at different stages of creative process.

Discussion

Contemporary researchers connect the functional role of theta rhythm not only with the regulation of emotions, but consider that it can also be a sign of directing attention outward; the readiness of a test subject to perform a task; intensity of effort; and the creation of conditions of increased neuron plasticity (Korobejnikova, 2011). On the basis of the above, we concluded that the indicators of coherence

in theta band of the research participants' EEG can reflect the intensity of effort exerted to create an artistic image, and can be a sign of concentration on directing attention outward.

Hence, the local zones of intensity of effort were revealed at theta band at the stage of viewing of monotypes—in the right posterior area that is engaged in processing image information, as well as in integrating images into one coherent spatial image. The left-hemispheric functional connections—at the stages of image creation and thinking over its details—reflect the engagement of information analysis mechanisms. The detected enhancement of coherent connections in the right frontal area, and the interhemispheric anterior connections at different stages of artistic image creation at theta band, can represent peculiarities of the engagement of active attention mechanisms in different artistic professionals.

Scientists declare that the functional role of alpha1 rhythm is connected with a general state of activation, the actualization of intuitive processes, internal information processing, and inhibition of information that is irrelevant to fulfilling the current task (Behtereva & Nagornova, 2007; Farber, Machinskaja, Kurganskij, & Petrenko, 2014; Fink & Benedek, 2014; Fink, Schwab, & Papousek, 2011).

The enhancement of posterior interhemispheric coherent connections that was revealed by our research coheres with contemporary views on changes in synchronization of alpha rhythm in modally-specific cortex zones (Farber et al., 2014), and with the opinion that an enhancement of alpha rhythm reflects inhibition of any distracting and interfering information flowing from the visual system (Fink et al., 2011). The increased intensity of frontal interhemispheric connections in **artists'** brains that was detected in the course of the research at the stage of image creation, can also indicate suppression of cognitive processes that are not directly related to the current tasks.

Contemporary scientists assert that the functional role of alpha2 rhythm relates to the specific character of information processing while solving cognitive tasks. It is believed that the right frontal region is involved in spontaneous production of non-verbal representations, and that the left one carries out control, gives additional assessment and analysis, and provides for the purposeful extraction of information from episodic and semantic memory (Razumnikova, Finikov, 2011). On the basis of the above, we concluded that the process of spontaneous image creation is launched later in the brains of the **artists**; while mechanisms of analysis and assessment of the given material (monotypes) dominate during the viewing of monotypes. The total creative process of **actors** is based on the search for possible associations, and spontaneous image generation.

Thus, representatives of all the artistic professions exhibited:

- strong short-distance intra-hemispheric connections in theta band, the presence of which can reflect the existence of local zones of intensity of effort: at the stage of viewing of monotypes, in the right posterior region; at the stage of image generation and thinking over its details, in the left hemisphere;
- strong interhemispheric connections at alpha1 band, which can reflect the suppression of cognitive processes that are not directly related to the current task: **actors** have it at the stage of viewing of monotypes; **artists**, at the stage of image creation;

- strong intra-hemispheric connections at beta band at all stages of artistic image creation and a decrease of interaction between hemispheres while searching for remote imaginative associations—i.e. conceiving the picture concept.

The **actors** demonstrate strong interhemispheric frontal connections in theta band, which likely provide the peculiarities of the involvement of voluntary attention mechanisms. The distribution of functional connections of the brain cortex of the **actors** at alpha2 band has mainly right-hemispheric localization. Moreover, it provides a simultaneous method of information processing for efficiently generating new images. The **artists** have equally distinct interhemispheric frontal connections at all stages of artistic image creation at theta-band (peculiarities of the involvement of voluntary attention mechanisms); increased coherence in posterior interhemispheric connections are observed at the stages of image creation and thinking over its details.

The distribution of functional cortex connections in alpha2 band is connected with equal involvement of right and left hemispheres during the process of imaginative creative activity in **artists'** brains; spontaneous generation of images and the mental design of artistic composition are promoted on this basis.

Conclusion

The results of this research permit us to draw the following conclusions:

1. The character of the brain's functioning during imaginative creative activity proves that all the females aged 23-27 participating in the research were highly emotionally involved in the creative process, and demonstrated similar levels of brain cortex activity at all the stages of the process.
2. The differences in brain cortex functioning when an artistic image is created by **artists** (close interaction of brain hemispheres) or **actors** (dominance of right hemisphere activity) reflect different strategies for carrying out imaginative creative work by representatives of these professions.
3. The analysis of the supplied monotypes and their assessment precedes the spontaneous and insightful creation of images by the **artists**. They create the general idea of an artistic image in their mind's eye, and then they think over the possibility of combining this idea and the supplied monotype into a holistic image.
4. A distinct, simultaneous way of processing the information provided for the efficient generation of new images is typical for **actors**. Their creative process is based on the search for possible associations, and spontaneous image generation.

These results can be used in education to develop creative and artistic potential in students, and in vocational guidance and training for artists, actors and other representatives of the artistic sphere. Our results may also be used in clinical psychology and medicine for psychotherapy and art therapy, for personal psychocorrection (to release the patients' creative potential), and for treating mental and somatic diseases as well.

Perspectives for further investigation of the problem include studying the main neurophysiological correlates of the creative process per se independent of a specific professional domain. It is not surprising for an **artist** to show different brain activity patterns from those of a non-artist, when he/she is thinking about an artistic image. The question remains whether an **artist** shows the same brain activity when thinking about an artistic image as the **actor** does when thinking about the image of an actor's role, or as a musician does when thinking about music, for example. The results obtained demonstrate the need for current models of the neural basis of the creative process to be developed further.

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Vygotsky in applied neuropsychology

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The aims of this paper are: 1) to show the role of clinical experience for the theoretical contributions of L.S. Vygotsky, and 2) to analyze the development of these theories in contemporary applied neuropsychology. An analysis of disturbances of mental functioning is impossible without a systemic approach to the evidence observed. Therefore, medical psychology is fundamental for forming a systemic approach to psychology. The assessment of neurological patients at the neurological hospital of Moscow University permitted L.S. Vygotsky to create, in collaboration with A.R. Luria, the theory of systemic dynamic localization of higher mental functions and their relationship to cultural conditions. In his studies of patients with Parkinson's disease, Vygotsky also set out 3 steps of systemic development: interpsychological, then extrapsychological, then intrapsychological. L.S. Vygotsky and A.R. Luria in the late 1920s created a program to compensate for the motor subcortical disturbances in Parkinson's disease (PD) through a cortical (visual) mediation of movements. We propose to distinguish the objective mediating factors — like teaching techniques and modalities — from subjective mediating factors, like the individual's internal representation of his/her own disease. The cultural-historical approach in contemporary neuropsychology forces neuropsychologists to re-analyze and re-interpret the classic neuropsychological syndromes; to develop new assessment procedures more in accordance with the patient's conditions of life; and to reconsider the concept of the social brain as a social and cultural determinant and regulator of brain functioning. L.S. Vygotsky and A.R. Luria proved that a defect interferes with a child's appropriation of his/her culture, but cultural means can help the child overcome the defect. In this way, the cultural-historical approach became, and still is, a methodological basis for remedial education.

Keywords: psychological theory and clinical practice, Vygotsky and Luria, Parkinson's disease, mediation, cultural-historical approach

Introduction

L.S. Vygotsky is traditionally associated in psychological science with developing the theoretical foundations of psychology, such as the cultural-historical approach; the biological and social determination of child development; the origins

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of higher mental functions; the nature of human conscience; communication and generalization; mediation, and so on. The role of clinical practice — studies of pathological cases — in his developing these theories is often underestimated in professional papers analyzing Vygotsky's contributions. The same is true for the perception of other general psychologists such as A.N. Leontiev (Glozman, 2004).

"The new psychology started from practice, not from theories: pedagogical, developmental psychology, and abnormal development (L.S. Vygotsky); clinical work and twins studies (A.R. Luria); concept formation in schoolchildren (A.N. Leontiev); the psychological bases for the formation of story-telling and intelligence in children (A.V. Zaporozhets); children's appropriation of simple means (P.Ya. Halperin); the development of memory in schoolchildren (P.I. Zinchenko) — the list could go on and on. These were practical tasks, solved by the group directed by L.S. Vygotsky, and after his death, by A.N. Leontiev and A.R. Luria. They worked hard and happily. Theory was their means, not their purpose" (Zinchenko, 1983, p. 9). These conditions can be explained not only by the fact that the pathology is revealing what is hidden in normal people, but an analysis of disturbances in mental functioning is impossible without a systemic approach to the evidence observed. Therefore, medical psychology is fundamental to forming a systemic approach to psychology.

The aim of this paper is: 1) to show the role of clinical experience for the theoretical contributions of L.S. Vygotsky, and 2) to analyze the development of these theories in contemporary applied neuropsychology.

The 1920s

In 1917, L.S. Vygotsky started work in his native town of Gomel, Byelorussia, assessing and helping children with vision and hearing loss, as well as with mental retardation. He presented this work at the International Conference on the Education of the Deaf in London in 1925 (the only trip abroad Vygotsky ever undertook) (Vygotsky, 1925).

On January 6, 1924, Vygotsky presented his paper "The methods of reflexological and psychological investigation" to the Second All-Russian Congress on Psychoneurology in St. Petersburg (first published in 1982). In this presentation, Vygotsky criticized the reflexological approach because of a "declarative, schematic characterization of reflexological studies of the complex human behavior" (Vygotsky, 1924/1982, p. 43), and for the first time declared the need for a systemic approach to understanding mental functioning: "New tasks need new means… Reflexes don't exist separately but are a part of complex systems, complicated formations that determine human behavior" (*Ibid*, p. 49). This presentation deeply influenced A.R. Luria and corresponded to his ideas about the systemic nature of human mental functions. Luria initiated Vygotsky's transfer from Gomel to Moscow, and obtained a place for him as a researcher at the Psychology Institute of Moscow University (Fig. 1).

Vygotsky continued his work with abnormal children in Moscow, and he created a "Medico-pedagogical center of the Narkompros (Ministry of Education) of the Russian Federation," which was later transformed into the Research Institute

of Defectology (now the Institute of Corrective Pedagogy). The main finding from these studies was "a bifurcation in the course of a child's behavioral development, into natural-psychological development and cultural-psychological development" (Vygotsky & Luria, 1930, p. 30). It was an application of the cultural-historical approach to developmental psychology.

Figure 1. A photo of the psychologists working at the Institute of Psychology, Moscow, in the late 1920s. Seated in the front row: Luria and Vygotsky (second and third from left, respectively). (Reproduced by courtesy of L. Mecacci)

In addition, starting in 1928, Vygotsky and Luria jointly organized the first laboratory of neuropsychology (25 years before the laboratory of neuropsychology at the Burdenko Institute of Neurosurgery) at the neurological hospital of Moscow University on Rossolimo Street. This laboratory is still in operation. His assessment of neurological patients permitted L.S. Vygotsky to create, with A.R. Luria, his theory of the systemic dynamic localization of higher mental functions and their relationship to cultural conditions. Vygotsky first presented this theory in his report on the Neurological Hospital of Moscow State University on Sept. 9, 1930**.** "The cerebral bases for mental processes do not lie in some isolated areas of the brain, but in complex systems of the whole brain" (Vygotsky, 1930/1982, p. 128). Very important is the reciprocal interaction between brain maturation and formation of mental functions. For the emergence of a function, a certain degree of maturity of the nervous system is required; but on the other hand, the functioning itself has an active and developing remedial effect, influencing the maturation of structural elements. In this work, Vygotsky also identified 3 steps of these complex systems development: "interpsychological — I order, you perform; then extrapsychological — I order myself; then intrapsychological — two points of the brain, excited from outside, have a tendency to work as part of the same system and become an intracortical point" (*Ibid*, p. 130). The biggest contribution to this theory came from the assessment of patients in this hospital with Parkinson's disease.

The study of Parkinson's disease and mediation theory

"Everybody knows that individuals with Parkinson's disease climb stairs well but have difficulty walking on the floor. To take a patient to our laboratory we needed to put strips of paper on the floor… An individual with Parkinson's disease makes a connection between 2 areas of his brain through a peripheral sign." (*Ibid*, p. 129). These new formations have a cultural origin, a dynamic psychological structure, and a dynamic brain (body) organization as well. In the late 1920s L.S. Vygotsky and A.R. Luria created a program for compensation of motor subcortical disturbances in Parkinson's disease (PD) through cortical (visual) mediation of movements. According to Vygotsky and Luria, mediation is a natural process of cognitive development in children, and of psychological compensation for cognitive and physical deterioration in both children and adults. The program they proposed consisted of two main stages: 1) the training stage, when the patient learned to use visual cues, with a gradual decrease in external cueing; and 2) the internalization stage, when the external cues are gradually replaced by their internal images, which become internal means for the patient to control his/her own motor behavior.

In continuing Vygotsky's and Luria's work (Sozinova, Glozman, Levin, & Unishenko, 2005) we differentiated 4 steps: 1) the *diagnostic phase* (determining the degree of walking disturbances and the efficiency of patient rehabilitation); 2) the *training phase* (walking on strips with the progressive increase of the distance between them); 3) the *internalization phase* (gradual reduction of the cues, with the instruction to imagine them during walking); and 4) *the automation phase* (patients walked without strips, singing or reciting a poem, or answering questions while walking).

We also applied different *means of mediation* for both motor and cognitive rehabilitation of parkinsonian patients. We used *visual means* (external marks for walking and orientation in space; frames for writing; externalized numbers or signs for counting and attention); *semantic means* (logical analysis in counting and problem solving; actualization of semantic relations for memorization; actualization of image and word relationships for vocabulary and memorization); and *emotional means* (computer games for spatial orientation and vocabulary; competitive situations; biological feedback). These complex systems of mediation proved their efficiency both for rehabilitation of parkinsonian patients and remediation of learning disabled children (Glozman, 2011). (*Fig*. 2).

So, teaching strategies are not only a means to learn culture — to form or to remediate mental functions; they are cultural instruments in themselves. "The higher mental function is a social means of behavior, converted within one's self" (Vygotsky, 1978).

We also tried to answer the question as to why two patients with the same degree of severity of the disease, similar treatment, and symptomatic regression, have completely different emotional reactions to their situations. To explain this well-known fact, we propose to distinguish between the *objective mediating factors,* like reeducative techniques and modalities, and *subjective mediating factors,* like the internal representation of one's own disease, a factor that determines the quality of life of the patient and his caregiver. This concept of internal representation of one's own disease was proposed by A.R. Luria's father, R.A. Luria (1935), to describe

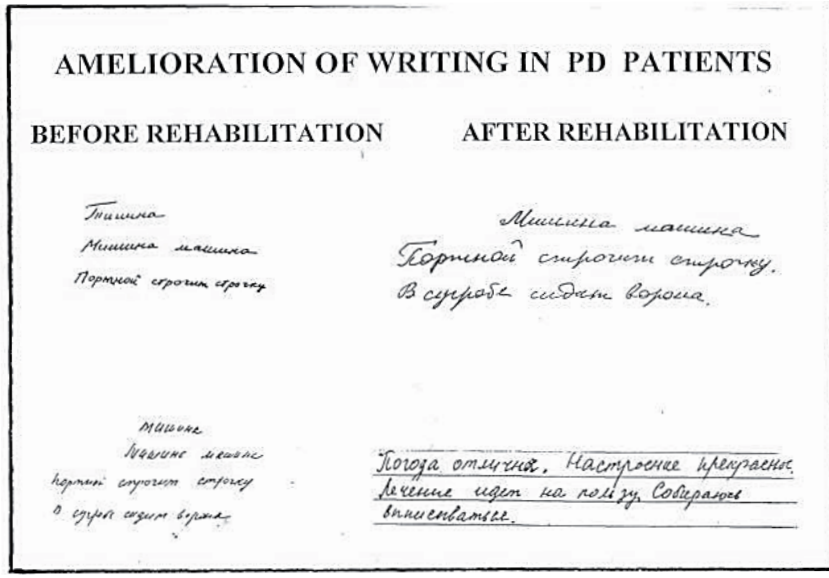

Figure 2. Rehabilitation of micrographia in patients with Parkinson's disease (PD) by means of visual frames

"everything the patient feels, the whole complex of his sensations… the patient's inner world, representing complex combinations of sensations and perceptions, emotions, affections, conflicts and mental trauma" (p. 56). The author described the structure of the internal representation of the disease (IRD), including the sensitive aspect (emotional reaction to one's own disease), the cognitive aspect (mental representation of one's own disease), and the voluntary aspect (one's active attitude toward surmounting the disease). Based on this theory, we proposed three types of internal representation of disease:

1. ANOSOGNOSIC — characterized by low scores for all three aspects of IRD; high cognitive deficiency; a middle score for quality of life of the patient; and a very low score for quality of life of his/her caregiver.

2. HYPOCHONDRIAC — characterized by a high score for sensitive aspect of IRD, middle for the cognitive aspect, and very low for the voluntary one; severe depression; low scores for quality of life for both the patient and his/her caregiver.

3. BALANCED — characterized by high scores for the sensitive and voluntary aspects of IRD, and middle for the cognitive one; high scores for quality of life for both patient and his caregiver.

This classification permits us to define the task required for rehabilitation of subjects with Parkinson's disease: to form a balanced type of internal representation of the disease as a subjective mediating factor. The proof of the importance of this task is the evidence that a change in internal representation of one's own disease's characteristics mediates the reduction of Parkinsonian symptoms with treatment, and a change in the internal representation of one's own disease precedes symptom change. The role of emotion in regulating the genesis of a psychosomatic syndrome was also proven for patients with essential hypertension (Zinchenko, Pervichko, & Ostroumova, 2013).

In this light, I consider that a patient's quality of life and satisfaction with treatment should be calculated not so much by the absolute degree of preserved ability (the "quantities" of life, according to Bergsma & Engel, 1998, p. 276), but through the relative preservation, compared with the premorbid level of ability, in the patient's subjective representation of the disease. Therefore, emotional and social factors, familial and recreational functioning, are closely associated with one's quality of life. Such an approach, I think, corresponds to Vygotsky's cultural-historical approach to neuropsychology.

Conclusion

The cooperation of outstanding psychologists L.S. Vygotsky and A.R. Luria on theoretical, experimental, and clinical work was an historic event, a scientific phenomenon, and a turning point in the development of psychological science and applied neuropsychology.

The cultural-historical approach to neuropsychology forces neuropsychologists to re-analyze and re-interpret classic neuropsychological syndromes (Ardila, 2013; Kotik-Friedgut & Ardila, 2014); to develop new assessment procedures more in accordance with the patient's conditions of life, because it was shown that well-educated and brain-damaged individuals showed neuropsychological performance similar to that of non-brain-damaged but illiterate individuals (Agranovich, 2004; Puente, 2012); and to reconsider the concept of the social brain as a social and cultural determinant and regulator of brain functioning (Glozman & Krukov, 2013). The cultural-historical approach in neuropsychology also permits us to differentiate the *biology of health (*evaluating MRI and blood tests, IQ, number of symptoms upon DSM-V or MKB-11, and so on), where the patient is a passive *object of evaluation*, from the *psychology of health* (the internal representation of one's own disease, the premorbid value of disturbed activity, self-appraisal, sano-genetic potentials, system of social relations, and more), where the patient is a *subject of his/her own disease***.**

Vygotsky's theories and evidence from his clinical work are of fundamental importance for developmental neuropsychology (Glozman, 2011). L.S. Vygotsky and A.R. Luria proved that a defect interferes with a child's appropriation of his/her culture, but cultural means can help the child overcome the defect. In this way, the cultural-historical approach became, and still is, a methodological basis for remediating education, and clinical neuropsychology becomes more than a scientific or "romantic" activity; it becomes an agent of social action.

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Luria's model of the functional units of the brain and the neuropsychology of dreaming

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Traditionally, neuropsychology has focused on identifying the brain mechanisms of specific psychological processes, such as attention, motor skills, perception, memory, language, and consciousness, as well as their corresponding disorders. However, there are psychological processes that have received little attention in this field, such as dreaming. This study examined the clinical and experimental neuropsychological research relevant to dreaming, ranging from sleep disorders in patients with brain damage, to brain functioning during REM sleep, using different methods of brain imaging. These findings were analyzed within the framework of Luria's Three Functional Unit Model of the Brain, and a proposal was made to explain certain of the essential characteristics of dreaming. This explanation describes how, during dreaming, an activation of the First Functional Unit occurs, comprising the reticular formation of the brainstem; this activates, in turn, the Second Functional Unit — which is formed by the parietal, occipital, and temporal lobes and Unit L, which is comprised of the limbic system, as well as simultaneous hypo-functioning of the Third Functional Unit (frontal lobe). This activity produces a perception of hallucinatory images of various sensory modes, as well as a lack of inhibition, a non-self-reflexive thought process, and a lack of planning and direction of such oneiric images. Dreaming is considered a type of natural confabulation, similar to the one that occurs in patients with frontal lobe damage or schizophrenia. The study also suggests that the confabulatory, bizarre, and impulsive nature of dreaming has a function in the cognitive-emotional homeostasis that aids proper brain function throughout the day.

Keywords: dreaming, brain, neuropsychology, functional units, Luria´s model

Introduction

Since its beginning, neuropsychology has focused on identifying the brain functions corresponding to psychological processes known as "higher processes", such as attention, motor skills, perception, memory, language, and conscience, as well as their corresponding disorders (e.g., inattention, apraxia, agnosia, aphasia). However, there are psychological processes that have received little attention in

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this field; among them is the process of dreaming. Over the last few decades, interesting neuropsychological findings have started to surface about the relationship between the production and recollection of oneiric processes. Such research has been examined here. We can start by asking ourselves: Are dreaming, or dreams, a subject of study for neuropsychology? Although no one definition of neuropsychology has been accepted throughout the field, Alexander R. Luria (1974), considered the founder of modern neuropsychology, defined it as follows: "A new branch of scientific knowledge, the main aim of which is to investigate the role of specific brain systems, in the complex forms of mental activity." According to this definition, we can pose the following question: Is dreaming a complex form of mental activity?

To answer this question, it would be of great help to describe the phenomenology of dreaming. Dreaming is an active psychophysiological process that involves the presence of perceptible hallucinatory images during sleep (i.e., the visual, auditory, tactile, kinesthetic, and linguistic kind), and cognitive activity with an emotional content of variable intensity that has been generated internally (Desseilles, Dang-Vu, Sterpeinch, & Schwartz, 2011). The content of the dream is bizarre by nature, with bizarre defined as featuring incongruities and discontinuities in the time, space, and the characters that appear in it (Corsi-Cabrera et al., 2003). Furthermore, there is a lack of control over the course of dream scenes, in which there are often violations of the laws of physics. All of this is due to a lack of critical thinking that can evaluate the coherence, or the lack thereof, of what is happening, so there is a passive and uncritical acceptance of everything that happens (Corsi-Cabrera et al., 2003). Arthur W. Epstein (1984) says that "dream formation involves a complex psychological activity that integrates memory, language, and thinking itself". If, after this, we assume that reality training is a complex form of mental activity, the next questions would be: Which particular brain systems are involved in this process? What are the differences between the neuropsychological systems involved in the conscious processes of wakefulness, and the ones involved in dreaming?

Obviously dreams have interested and captivated humanity since ancient times. It was not until 1900, however, that Sigmund Freud (1966) published his book "The Interpretation of Dreams," which included the first scientific approach to the subject from a purely psychological point of view. The first approach toward psychobiological scientific research on the subject of dreaming occurred in 1953 when Aserinsky and Kleitman from the University of Chicago published their research, which stated that sleep with rapid eye movement, known as REM sleep, is frequently associated with dream recall. Since then, we have learned that human sleep is made up of two phases: REM sleep, which is generally associated with dreaming, and non-REM sleep, or sleeping without rapid eye movement, from which very few dreams are recalled. In the REM phase, the eyes move rapidly in all directions, and upon waking up, people frequently report having dreamt. During this phase, there is also an increase of electroencephalographic (Rechtschaffen & Kales, 1968) and cerebral metabolic activity, which is equal to or greater than that activity during wakefulness (Braun et al., 1997; Madsen, 1993; Maquet et al., 1996; Sakai, Meyer, Karacan, Derman, & Yamamoto, 1980). Penis erection also occurs in males (Fisher, 1973), as well as increases in heart rate (Aldredge & Welch, 1973; Žemaitytė, Varoneckas,

& Sokolov, 1984). All this intense psychophysiological activity is accompanied by muscle atonia (Berger, 1961), the function of which, some authors have mentioned, is to avoid the translation of the dream into action (Fisher, 1973). On the other hand, we find non-REM sleep characterized by a decrease in psychophysiological activity in general (Téllez, 1998).

Luria´s model of brain functioning: The Three Functional Units model

As has been previously mentioned, dreaming is a psychophysiological process as active as wakefulness; however, little is known about the neuropsychological systems involved. Therefore, the objective of this article is to present a neuropsychological model of dreaming based on the most relevant clinical, experimental, psychophysiological, and neuropsychological research. To present our proposal about the generation and bizarre content of dreaming, we took as a general framework Luria's Three Functional Units Model (Luria, 1974), which attempts to explain the neuropsychological functioning of human beings during wakefulness.

A) The First Unit is made up by the structures of the brainstem, specifically, the reticular activation system, thalamus, and monoaminergic cell groups in the brainstem, which function to activate and keep the general cortical tone needed to activate, the cerebral cortex, generating a state of alertness (Magoun, 1964; Grønli, & Ursin, 2009).
B) The Second Unit is formed by the parietal, occipital, and temporal lobes, and is responsible for obtaining, processing, integrating, and storing sensory information from the environment.
C) The Third Unit is formed by the frontal lobe, which is in charge of the selection, planning, execution, and direction of a person's pattern of behavior, as well as its evaluation. It also includes vital cognitive functions such as sustained attention, awareness, and insight (Luria, 1974; Cummings, 1995; Stretton, & Thompson, 2012).

Although Luria does not explicitly mention it, we believe it is convenient to incorporate the limbic system as a Fourth Unit:

D) Unit L, which includes the hippocampus, amygdala, and fornix, comprises the limbic system, as well as para-limbic structures, such as the cingulate gyrus and the para-hippocampal and orbitofrontal regions. This Unit is responsible for emotional responses and the consolidation of the memory (Téllez et al., 2002).

The Three Unit Model during REM sleep

During REM sleep, there is an activation of the First Unit similar to what occurs in the state of wakefulness, which manifests itself with an increase of the electroencephalographic and metabolic activity in most regions of the brain. Hobson and Stickgold (1995) found that during REM sleep, activation of the brainstem starts in the cholinergic system on a pontine level. Studies with positron emission computerized tomography (PET) have confirmed an increase in the brainstem's metabo-

lism (Braun et al., 1997), which generates electroencephalographic and metabolic activation, as well as stimulates of the posterior cortical and subcortical areas, especially the limbic-emotional system.

However, the activation of the First Unit during dreaming is not completely the same as in wakefulness because a cortical motor inhibition occurs, producing motor paralysis (Berger, 1961; Fisher, 1973).

The activation of the First Unit also differs from that in wakefulness, in that it produces a greater stimulation of the structures in Unit L, the unit that produces emotional activation (Calvo, 1995). This has been confirmed by experimental studies in animals and humans. For example, it has been reported that the stimulation of the cingulate gyrus in humans causes complex hallucinatory phenomena, emotional changes, rapid eye movement, and oneiric sensation. Similar changes are reported following the stimulation of the hippocampus and amygdala (Calvo, 1995). It can be inferred that any variable that increases limbic system activity during dreams can cause differences in emotional intensity, ranging from little emotional content to nightmares.

As an example, the cases of patients with areas of epileptogenic activity in the limbic and paralimbic regions (Unit L), as in the case of the temporal lobe epilepsy, show a higher dream-recall frequency than patients with generalized tonic-clonic seizures and normal people (Epstein, 1984; Maquet et al., 1996). Some authors have found that individuals with limbic hyper-function, as indexed by increased scores on the Limbic System Checklist, report more threatening dream content than others (Peterson, Henke, & Hayes, 2002).

As a consequence of the activation of Unit 1, Unit 2 is stimulated, generating activation in visual, perceptive-imaginative, auditory, linguistic, spatial, and tactile functions.

Studies with PET have found that the visual and auditory secondary areas are especially metabolically active during REM sleep, even above levels found in wakefulness (Braun et al., 1997; Madsen, 1993). The activation of the visual system is manifested through PGO spikes (bioelectric activity that comes in a synchronized way from the pons, lateral geniculate body, and the occipital cortex) that are associated with rapid eye movement, giving way to dreams with visual predominance (Calvo, 1995; Hong, Gillin, Dow, & Buchsbaum, 1995). Several studies agree that lesions in the areas involved in visuospatial processing and representation in Unit 2, result in a reduction in, or elimination of, dreaming, a neuropsychological syndrome called "anoneria". These disturbances of the dreaming process are positively correlated with the appearance of some type of agnosia (Doricchi & Violani, 1992; Kerr & Foulkes, 1981; Murri et al., 1992; Peña-Casanova, Roig-Rovira, Bermudez, & Tolosa-Sarro1985). For example, Peña-Casanova et al. (1985) reported a case of a patient with a lesion in the left temporo-occipital region due to a cerebrovascular accident. This patient lost the ability to dream and also showed optic aphasia, optic apraxia, aphasia without agraphia, and color agnosia.

In the meantime, Unit 3, or the frontal lobe, simultaneously suffers an inhibition of some of its regions and an activation of others. The frontal lobe can be divided into two regions: the motor region (Brodmann areas 4, 6, and 8) and the non-motor region, or prefrontal lobe (Areas 9, 10, 11, 44, 45, 46, and 47). The prefrontal lobe is divided into three regions:

1) The dorsomedial region, which is associated with executing functions such as the formulation of goals, working memory, planning, execution of plans, and the self-regulation of behavior; 2) the orbital frontal region, which is related to the inhibition and control of impulses and social tact; and 3) the medial region, which has been related to motivation and the process of thinking what another person is thinking, also known as mentalization, a second order process of representation relevant to social skills (Frith, 2007). In general, the prefrontal lobe has been associated with selection functions, programming, and direction of behavioral planning, and impulse inhibition, as well as critical and reflexive thought (Cummings, 1995; Luria, 1974; Tsvetkova, 1996).

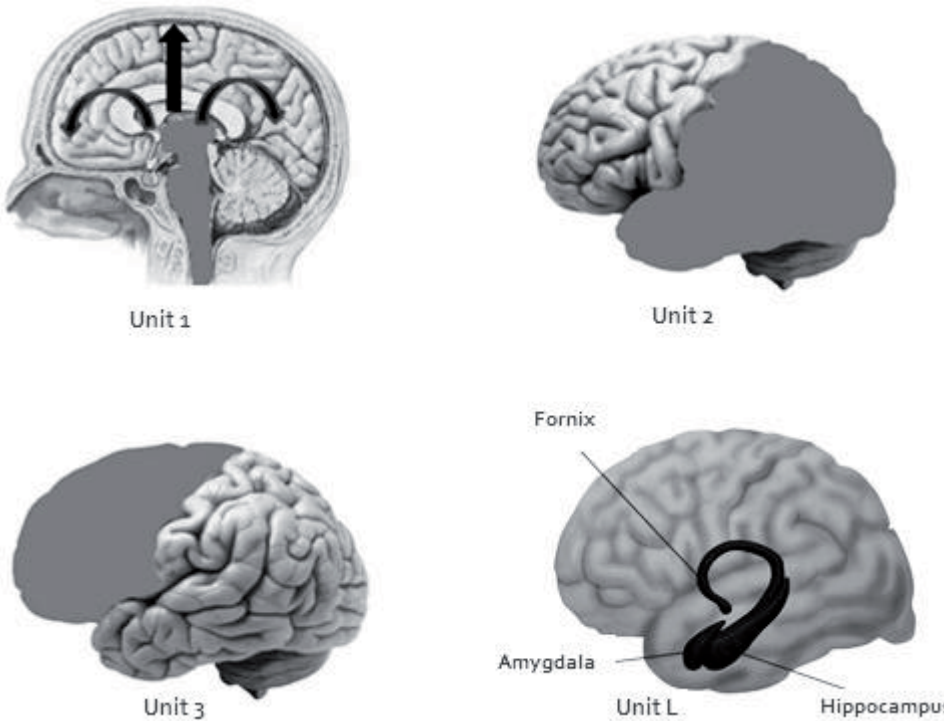

Figure 1. This picture shows the four Functional Units of the Brain: Unit 1(reticular system), Unit 2 (parietal, occipital and temporal lobes), Unit 3 (Frontal lobe) and Unit L (limbic system).

It has been proven through PET and functional magnetic resonance imaging (fMRI) that during dreaming, there is an activation of the primary and supplementary motor areas, such as the frontal ocular area (Brodmann's area 8), which is activated by Unit1 and then collaborates in producing the rapid eye movements of REM sleep (Hong et al., 1995). The activation of the supplementary motor area (Brodmann's area 6) and primary motor area (Brodmann's area 4) produces a programming and activation of a sequence of corporal movements during the oneiric content; but said activation remains on a representational level, because an inhibition occurs in the caudal region of locus coeruleus located in the pons of the brain stem (Unit 1) due to hyperpolarization of the motoneurons in the spinal cord. This

generates a general muscle paralysis (with the exception of ocular movement), that prevents the dream from becoming an action (Berger, 1961; Jouvet, Sastre, & Sakai, 1981). Other areas that are activated are the prefrontal medial region and the part that corresponds to the anterior region of the cingulate gyrus (Braun et al., 1997; Buchsbaum et al., 1989). These structures have a connection with Unit L.

Moreover, the dorsolateral region of the prefrontal lobe (Brodmann's areas 9, 10, 45, 46, 47) and the orbital frontal region (Brodmann's areas 11 and 12) show an inhibition during dreaming. Madsen (1993), using PET, found a drop in metabolism in the orbitofrontal region during REM sleep. Using the same technique, Maquet et al. (1996) found a decrease in the activity of the frontal lobes and an increase in the amygdaloid complex. It is well-established that lesions or dysfunction in this area in neuropsychological patients result in uninhibited, impulsive, and bizarre behavior.

Years later, using PET with H2150 radioactive tracers, which are the most suitable for sleep research, Braun et al. (1997) found low metabolism in the orbitofrontal and dorsolateral regions of the prefrontal lobe during REM sleep, as well as in the inferior parietal association, and simultaneously, an increase in metabolism in the visual and auditory association areas of Unit 2. Doricchi and Violani (1992) and Murri et al. (1992) found that frontal lesions do not affect dreaming, and some patients with frontal damage show an increased frequency of nightmares (Colace1, Salotti, & Ferreira, 2015), indirectly confirming the previously mentioned PET findings. This also supports the hypothesis that Unit 3 is inactive and not necessary for the dreaming process.

Other indications that the prefrontal lobe is hypo-functioning during dreaming come from comparing studies of interhemispheric and intra-hemispheric electroencephalographic correlation during wakefulness, REM, and non-REM sleep. Corsi-Cabrera et al. (2003) found an absence of electroencephalographic correlation between the frontal and perceptual regions, as well as an increased correlation among the perceptual regions. These researchers suggested that this temporary dissociation between the executive and perceptual areas is the cause of the characteristic bizarreness of dreams.

That being said, it can be expected that, upon the activation of Unit L and a simultaneous decrease in the functioning of the prefrontal lobe during wakefulness, any person could behave in an uninhibited, impulsive or aggressive way, with difficulties in planning and self-regulation. Such can be the case of people with schizophrenia (Gershon & Rieder, 1992; Goldberg, 2002) and major depression (Beck, 2008), and the 75% of criminals who exhibit low metabolism in the prefrontal lobe during wakefulness (Goldberg, 2002; Gibbs, 1995). During REM sleep in normal people, there is an increase in the activity of Unit L and a decrease in Unit 3; however, we cannot observe the behavioral effects, due to the activation of the cerebral mechanisms that produce the muscle paralysis that comes with this type of sleep, preventing the body from acting out dreams.

On the contrary, experiments with cats that had the coeruleus alfa nucleus damaged — the nucleus which seems to be responsible for the motor paralysis during REM sleep — have caused these animals to translate their "dreams" into behavior, which is generally manifested in rapid behavioral sequences of, for instance, attack, rage, and grooming. These behaviors are not directed towards an objective,

because when a piece of meat or a mouse is placed near them, they do not seem to notice them, and they continue with their stereotypical behavior. Furthermore, the cats' pupils display miosis and are covered by the nictitating membranes in same way as during REM sleep. This phenomenon has been called "oneiric behavior" (Jouvet et al., 1981). Jouvet et al. (1981) make an interesting observation about animal behavior: "Some cats that exhibited friendly behavior during daytime, showed a large incidence rate of aggressive behavior during REM sleep". This can be interpreted as the result of a broad activation of Unit L without a cortical regulation (Buchsbaum et al., 1989).

In the case of humans, it is interesting to find a clinical sleep disorder that is similar to the "oneiric behavior" experimentally induced in cats. This disorder is named "REM sleep behavior disorder" (RBD) and is characterized by the absence of the muscle paralysis which is customary during this stage of sleep, as a result of neurological related disorders. In contrast to sleepwalking, which occurs during the slow-wave stage of non-REM sleep and in people who generally behave in a peaceful way, patients with RBD frequently have accidents and carry out physical and verbal assaults on other people during these episodes (Tellez, 1998; Schenck, Bundlie, Patterson, & Mahowald, 1987; Schenck, Milner, Hurwitz, Bundlie, & Mahowald, 1989). This behavior is very similar to that of the Jouvet et al. (1981) cats and is the result of the activation of Units 1, 2, and especially L, along with the simultaneous inhibition of the prefrontal lobe. RBD seems to be an early warning sign of Parkinson's disease, as some authors have noted that 65% of patients with this sleep disorder develop the disease within an average of nine years after RBD shows up (Abbott, 2005), indicating the degenerative etiology of this disorder. Thus, RBD also represents an etiological model for the study of oneiric behavior.

The model of the Four Units of dreaming: A proposal

The findings cited above allow us to suggest that the nature of the oneiric content during dreaming is caused by the simultaneous inhibition of (1) the prefrontal lobe in the dorsolateral region — the region that is in charge of the executive functions, (2) the orbitofrontal region, that relates to the regulation of limbic impulses, as well as (3) the parietal-temporal-occipital (PTO), that is involved in visuo-spatial recognition, symbol processing, and face and object recognition. Thus, the main proposal of this model, is that the characteristics of the oneiric content -that is, the lack of planning and control of critical and coherent thought toward what is dreamt, as well as the ease by which emotional and motivational impulses emerge in dreams — basically correspond to an increase in the activity of Unit 1, 2 (with the exception of the PTO region), Unit L, and the medial region of the prefrontal lobe that occurs simultaneously with the inhibition of the dorsolateral and orbital regions of Unit 3 (Figure 1). This leads us to think of the oneiric process as basically a process of confabulation, suggesting that dreaming is a type of normal confabulation that happens every night in a cyclical way, but does not differ much from the confabulatory thoughts of patients with frontal lobe damage. Luria (1974) mentioned that the confabulations of these patients are similar to the oneiric states in terms of the loss of the selectivity of mental processes, which is typical of the normal conscious life (Figure 1).

Meanwhile, Koukkou and Lehman (1983) have suggested that the cerebral state of an adult during dreaming corresponds functionally to the state of wakefulness during childhood, based on the similarity of the electroencephalographic activity of the different phases of sleep and in human development phases. They suggest that every time we dream, there is an age regression in our psychophysiological functioning that causes us to have access to cognitive memories and strategies of that younger age. They also suggest that these cognitive strategies during adult dreaming are equivalent to the processes of fantasy, and are far from the reality thought of a young child during wakefulness (Piaget's preoperational stage). Some data indicate that the prefrontal lobe does not reach maturity until between the ages of 10 to 12 years (Welsh & Pennington, 1988). Then, according to this hypothesis, a functional regression of cognitive activity in dreaming would imply incomplete functioning of the prefrontal lobe.

On the other hand, the recollection of dreams becomes interesting. It is well known that dreams are difficult to remember in wakefulness (Fisher, 1973). This is possibly explained through the state-dependent theory (Koukkou & Lehmann, 1983). According to the model presented in this research, dreams are difficult to remember precisely because of the lack of working memory due to the relative deactivation of the prefrontal lobe. It has been proven through fMRI that the degree of activation of the frontal lobe and the para-hippocampal region of the limbic system during the presentation of semantic and visual non-verbal information predicts its subsequent recall, showing the important role of these two structures in memory (Brewer, Zhao, Desmond, Glover, & Gabrieli, 1998; Wagner et al., 1998). During dreaming, only the limbic region is activated, not the prefrontal; this fact produces a partial or total loss of memory of the oneiric content upon waking up in most people (*Figure 1*).

We can conclude that dreams, as well as cognitive activity in wakefulness, come in various forms and contents. For example, there could be dreams with a very high emotional content due to the intense activity of Unit L, a high imaginative-visual content with an increase of activity in the right hemisphere of Unit 2, or a high narrative-linguistic content produced by the left hemisphere, but always partnered with an inhibition of the dorsolateral and basal regions of Unit 3. It has been shown that "lucid" dreams are characterized by "being able to freely remember the circumstances of waking life, to think clearly, and to act deliberately upon reflection, all while experiencing a dream world that seems vividly real" (LaBerge, 1990). These are dreams where the control and direction of the oneiric process are maintained, and the dreamer is aware that he is dreaming. This is the result of an exceptional and sudden reactivation of the functioning of the dorsolateral and medial regions of the left prefrontal lobe and the temporoparietal region during REM sleep. During wakefulness, complex information processing is promoted by these regions, but they are not active during non-lucid dreaming. This pattern of brain activity explains the recovery of the executive metacognitive abilities and voluntary control that characterizes lucid dreaming (Dresler et al., 2012; Noreika, Windt, Lenggenhager, & Karim, 2010).

Foulkes (1982), whose studies were also based on Luria's work, suggested another model of brain functioning during dreaming. He suggested that dreaming is generated verbally in the left frontal lobe, which remains functional during REM

sleep and "that it competes with the basal affective and posterior associative systems that are left uninhibited during sleep". However, this model has not been entirely confirmed by recent studies with PET (Braun et al., 1997; Buchsbaum et al., 1989; Madsen, 1993; Maquet, 1996).

The function of dreaming: Cognitive-emotional homeostasis

We propose that the inhibition of prefrontal lobe functioning and the increase in activity of Unit L during REM sleep can have a cognitive and emotional homeostatic function that is important for good psychological performance during wakefulness. This process allows for an increase in prefrontal lobe functioning and a decrease of limbic activity throughout the day, allowing better impulse control, planning, and self-regulation of behavior.

This evaluation agrees with the "Motivational Theory of REM Sleep" by Vogel (1979), which suggests that the function of the REM phase of dreaming is to decrease the impulse-motivated behavior during wakefulness. This researcher proposes this theory in light of the observation that the selective deprivation of REM sleep in animals produces increases in aggressive, sexual, and food-seeking behaviors. It was also noticed that the deprivation of REM sleep in patients experiencing endogenous behavior improves their symptomatology (Vogel, Vogel, McAbee, & Thurmond, 1980). Meanwhile, Vogel (1979) argued that the decrease in the amount of REM sleep as a consequence of the use of antidepressant drugs, is caused by an increase in impulse-motivated behavior during wakefulness, and therefore, a clinical improvement of depression.

In his new model to explain depression, Beck (2008) affirms that in patients with depression, there is a hyperactivity of the amygdala that causes an excessive reactivity in the presence of negative events, and hypo-activity of the prefrontal lobe that prevents a proper interpretation of events and counteracts the high activity of the amygdala. In fact, patients with depression show an increase in the metabolism of the dorsolateral region of the prefrontal lobe during REM sleep instead of the decrease which is observed in subjects without depression. This then causes a decrease in activity in the dorsolateral region of the prefrontal lobe and an increase of activity of the limbic system, preventing the regulation and evaluation of social contexts and circumstances, sensations, and emotions in a suitable way during wakefulness (Nofzinger, 2005). As we have examined, the prefrontal lobe of the human being is extremely sensitive to sleep; its functioning is altered by sleep deprivation, and it benefits and recovers with sleep of good quality and quantity (Muzur, Pace-Schott, Hobson, 2002). The usual effects of sleep deprivation on the prefrontal lobe's functions are well known and include irritability, lack of attention and concentration, working memory impairments, and lack of self-regulation skills (Durmer & Dinges, 2005). Sleep deprivation makes us more sensitive to emotional and stress-induced stimuli (Vandekerckhove & Cluydts, 2010).

This finding also favors the hypothesis that frontal hypo-activity and limbic hyperactivity during REM sleep is really homeostatic, meaning that an increase in emotional and motivational activity works as an escape valve during the night without the logical, reasoned, and regulating activity of the prefrontal lobe, and

that during the day, the limbic activity decreases, and the dorsolateral and orbital activity of the prefrontal lobe increases.

Schwartz and Maquet (2002) suggested that the bizarre content of dreaming is similar to certain neuropsychological syndromes that produce visual and spatial agnosia. During REM sleep, the cerebral structures that are activated and deactivated are similar to the cerebral regions damaged in the cited neuropsychological syndromes. In addition to the content of dreaming, there is an absence of control over the course of the dream scenes due to lack of the critical thinking that evaluates the coherence of what is happening; therefore, there is a passive and non-critic acceptance of what is occurring during the dream (Corsi-Cabrera et al., 2003).

That is the reason why Hobson and Stickgold (1995) stated that dreaming represents a model for explaining schizophrenia. This is because of the cognitive and emotional similarities between them, such as the exaggeration of the emotional activity that contributes the deterioration of rationality and to the lack of selective attention and direction of cognitive knowledge which, besides being grotesque, contains a great quantity of confabulations. Furthermore, both conditions show similar neuropsychological functioning: a hypo-functioning of the frontal lobe and an activation of Unit L. These characteristics impede the schizophrenic patient and the dreamer from organizing their thoughts, integrating them with emotions, and turning them into appropriate actions. Schizophrenia studies with PET have shown diminished frontal lobe functioning.

It can be said that dreaming is a state similar to a "schizophrenic or frontal lobe syndrome," but temporary, normal, and healthy, so that the next day, the brain can carry out its homeostatic function, and promote optimal functioning of the dorsolateral and orbital region of the frontal lobe during wakefulness. In this way, the frontal lobe can carry out the functions of planning, execution, evaluation, attention, working memory, self-observation, better impulse control, and proper decision-making, allowing the individual to carry out a proper everyday life of social interaction.

Dresler et al. (2014) found that in lucid dreaming, the active brain structures are the ones that malfunction in schizophrenia, and this is what prevents patients from becoming aware of their pathological state. We can state that "the oneiric craziness of every night" is a necessary escape valve permitting the person to act sanely during the state of wakefulness. According to Solms (2000), a renowned researcher in the neuropsychology of dreaming, these data support the essential idea proposed by Freud (1966), who maintained that one of the functions of dreaming was to allow instinctive impulses to emerge (limbic) without the censorship mechanism (dorsolateral and orbital prefrontal regions), thus allowing the attainment of repressed desires in a safe way.

Finally, we would like to mention several research questions that result from this article: What is the oneiric content in a patient with prefrontal damage? How can it be proven that the hypo-functioning of the prefrontal lobe and the limbic hyper-functioning during dreaming fulfill a homeostatic need for good psychological functioning during wakefulness? There is a proven antidepressant effect of REM sleep deprivation (Vogel et al., 1980; Nofzinger, 2005). Does it produce changes in

the biochemical functioning of the prefrontal lobe and the limbic system? Answering these and other questions will allow continuing progress in this new and interesting field in the neurosciences: the neuropsychology of dreaming.

Conclusions

Luria´s Model of the Brain's Functional Units can be used to explain the generation of dreams and their characteristics. The similarity between dreaming, frontal lobe syndrome and schizophrenia are stressed, especially in terms of the confabulations, the lack of impulse control, and the lack of self-direction and monitoring that occurs in these disorders. In addition, the suggested hypothesis of the homeostatic character of REM sleep favors the idea that the brain works in an inverse way during the state of wakefulness to assist better psychological functioning of the individual.

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A cultural congruence test for primary school students

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The study presented in this article relies on the principles of the cultural-historical theory, which defines *cultural impact* as the main driving force behind psychological development. Based on the assumption that culture is a set of normative situations, the study identifies rules that are typical for primary school students in big Russian cities. These rules are grouped into what we refer to as *factors of cultural compliance*, which ultimately can be seen as indicators of pupils' cultural congruence. In specifying the cultural congruence of primary school students, we take into account not only the rules of school life but also the whole range of stable rules for children 7- to 10-years-old. Researchers at the Psychology Institute of the Higher University of the Chinese Academy of Science (Wang, Zhu, & Shi, 2011) call such rules usual or contextually usual. We include rules that govern the behavior of children who have cultural differences, so in this article we are talking about the rules that are typical for children of this age in Russia.

The goal of the study was to develop a test to diagnose the level of cultural congruence. The test was exposed to psychometric evaluation for validity, reliability, and discriminatory power. Factor analysis by means of varimax rotation provided for calibration of the rules by consolidating them into factors. These factors underpin the test and include the categories social interaction, academic competence, regulation, obedience, self-service, and self-control. In accordance with the principles employed in psychology, the factors confirm the construct validity of the test in relation to children's development when they are between 7 and 10 years old. The study confirms that learning is the main activity at this age by introducing a factor that brings together rules inherent in normative situations in the education process. The social setting for psychological development, viewed as a specific relationship between a child at the given age and the environment, is determined by the child's interaction with an adult. The factor of obedience is the key parameter for children of the age under consideration. New at this age are arbitrariness, self-regulation, self-analysis, and an internal action plan. Self-control is also conceptually linked to these factors.

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The study offers a new look at the cultural determination of psychological development in ontogenesis. Validated in the course of the investigations, the test can be used to diagnose cultural congruence — that is, the compliance of a primary school student with rules inherent in normative situations.

Keywords: primary school student, cultural congruence, normative situation, validity, reliability, discriminatory power

Introduction

Entering school, a child is facing a situation of increased standardization when he or she, just like the rest of the class, has to comply with a set of requirements, or rules, that reflect established cultural norms. The degree of compliance by a person with the rules of a normative situation indicates his or her cultural congruence. Compliance with rules by primary school students is regarded as a relevant problem that needs to be looked into. Although primary school age is one of the key periods for acquiring knowledge and skills, it imposes a whole range of rules and restrictions on students' activities.

Psychological issues of primary school students have been coming under heightened scrutiny. Manifested in, for example, attention deficit, poor self-control, and hyperactivity, these problems usually occur in a normative situation where a child fails to comply with the standards imposed on each and every student. Before we can provide a solution, we need to define the standard cultural context that contains these age-specific rules and pinpoint the factors that determine a student's ability to comply with a rule in a given normative situation. In addition, children display idiosyncratic differences in behavior under the same normative situation. For this reason the development of a special test to diagnose the ability of a child to comply with a rule in a cultural environment becomes important.

Conceptually, this diagnostic tool rests on a number of existing theories in psychology. The cultural-historical theory of L.S. Vygotsky (1928/1996) and his followers regarding the social determination of mental development in ontogenesis is the original theoretical basis. Outside cultural factors get internalized and eventually shape the internal ability of a person to control his or her own behavior. If we assume that a cultural rule is one of such outside factors, then the distinction between cultural behavior and natural behavior — one that is not regulated by cultural norms — becomes obvious. Psychology offers a clear theoretical substantiation for norm-abiding behavior when a normative situation is considered a unit of culture analysis (Veraksa, 2014). Further empirical studies identified psychological mechanisms for the internalization of rules inherent in normative situations at different ages (Pashchenko, 2010; Ulyanova, 2008; and others) and provided methodological analysis of the theory of normative situations from the perspective of Vygotsky's theory (Bayanova, 2011, 2013). Western scholars specializing in cross-cultural and social psychology have written many works defining the norm in human behavior and group behavior (Herskovits, 1955; Hofstede, 1991; Miller, 1988).

The field of developmental psychology does not provide many studies of the interaction of children of primary school age and the rules they are expected to

follow. Among such studies we can note the work of Chernyak and Kushnir (2014), who found that following a rule depends on the moral content of the rule. Research by Nielsen, Kapitany, & Elkins (2015) has shown that children may be culturally congruent without self-realization of their behavior; they are just imitating adults. Jordan, Cowan, & Roberts (1995) analyzed the process of children's assimilation of rules in sociodramatic games. In general, analysis of the works in the field of psychology on the interaction of a child and a rule shows that there are not enough techniques for measuring this behavior that have appropriate psychometric evaluation.

In designing the test, we made the assumption that the social setting for the development of primary school students features normative situations that could be combined into groups reflecting the typical rules that children of this age have to abide by. The aim of our study was to establish a test to differentiate children by their levels of cultural congruence. During the design stage, we assessed the validity, reliability, and discriminatory power of the test. In assessing its psychometric indicators, we used the methods that were employed to determine the feasibility of the test and the calculations generally accepted in the development of psychodiagnostic methods (Veraksa et al., 2014). The setting chosen was typical for large Russian cities with a population of more than one million people. Taking part in the research were students and teachers of primary schools where the language of instruction is Russian. These features determine the cultural context for further applications of the test.

Method

The aim of the research was the development and psychometric evaluation of a test to diagnose the compliance of a given primary school student with the rules inherent in normative situations typical for the age — that is, to determine his or her cultural congruence. To begin, we needed to identify the full range of rules that are typical for the age under consideration and that are inherent in normative situations; using such criteria would narrow down the definition of the cultural context. While developing a technique for measuring the cultural congruence of preschoolers, we had developed a specific algorithm for the study (Bayanova & Mustafin, 2016). We also used this algorithm while developing the technique for determining the cultural congruence of the primary school students studied in this research.

In the first stage we made a phenomenological assessment of the rules typical for the primary school students by surveying teachers, parents, and the children themselves; these respondents were required to complete sentences. The study involved 437 pupils in elementary grades (grades 2–4), 26 primary school teachers, and 324 parents of primary school students.

The pupils were asked to answer questions formulated as unfinished sentences: "Usually my mother sees to it that I do not...". "Every day, I definitely need to...". "At school, at home, and on the street adults can criticize if I...". "If I want to be an obedient pupil, I...". In response to these statements children reported on the rules that are addressed to them most often.

Parents were also asked to complete unfinished sentences aimed at identifying their ideas about compliance and incompliance with the requirements of the norms

expressed in the rules. The questions were as follows: "I believe that every child this age must...". "I scold the child at a party or on the street if he/she...". "At home I usually ask of a child that he/she...". "The most common requirements for a child's behavior are...". The questions for teachers also were unfinished sentences: "The most common requirements addressed to a child are...". "It is difficult for children to comply with the rules concerning...". "As a rule by the end of primary school all children follow the rules concerning...". "I am satisfied with children's work if they follow the rules concerning...".

In this stage, we analyzed the responses of 2,503 students in grades 2–4, 2,599 responses of parents, and 73 responses of primary school teachers. The content analysis of the rules imposed on children is described in our work (Bayanova & Tsivilskaya, 2014). The method of frequency analysis identified 55 rules specific to primary school age. Further, these rules were presented to teachers for evaluation on a 4-point scale according to the degree of compliance for the age. After that we conducted a factorial assessment.

In developing the cultural congruence test we relied heavily on the responses of our subjects. The procedure of factor analysis — with the help of varimax rotation — provided for the calibration of the rules (Table 1). After assessing by varimax rotation 55 statements of rules, we were left with 36 statements, which were then subjected to psychometric assessment.

Table 1. Factor matrix with components determining the compliance of primary school students with the rules in a normative situation

№	Statements reflecting the rules in normative situations typical for primary school students	Factor loading
	Factor 1: Social interaction	
1	The pupil takes care of younger children	0.712
2	The pupil keeps his or her promises	0.652
3	The pupil can play together with other pupils without conflicts	0.601
4	The pupil does not fight	0.591
5	The pupil does not lie or cheat	0.563
6	The pupil does not offend other children	0.463
7	The pupil does not call other children names	0.418
	Factor 2: Academic competence	
1	The pupil pronounces words correctly	0.751
2	The pupil thinks before saying something	0.723
3	The pupil makes correct statements	0.688
4	The pupil thinks before doing something	0.673
5	The pupil is literate	0.540
6	The pupil reads a lot	0.446
7	The pupil develops his or her memory	0.329

№	Statements reflecting the rules in normative situations typical for primary school students	Factor loading
	Factor 3: Self-control	
1	The pupil does not intervene when adults are talking	0.720
2	The pupil does not make noise	0.665
3	The pupil sits still	0.588
4	The pupil sits upright	0.550
5	The pupil does not make mistakes in his or her homework	0.507
6	The pupil is attentive	0.445
7	The pupil gets his or her school bag ready beforehand	0.413
	Factor 4: Obedience	
1	The pupil acts on his or her parents' instructions	0.725
2	The pupil does not leave home without permission	0.724
3	The pupil comes home on time	0.717
4	The pupil shows respect for seniors	0.564
5	The pupil makes his or her parents happy	0.545
6	The pupil obeys teachers	0.551
7	The pupil is not late	0.400
	Factor 5: Self-service	
1	The pupil keeps his or her room tidy	0.733
2	The pupil helps his or her parents	0.701
3	The pupil helps to clean up	0.693
4	The pupil follows personal hygiene rules	0.590
	Factor 6: Regulation	
1	The pupil does his or her homework	0.686
2	The pupil does not miss lessons	0.582
3	The pupil is obedient	0.572
4	The pupil gets good marks	0.326

Results

The study offers a procedure for psychometric assessment of reliability, discriminatory power, and validity. According to calculations, the test has a high index of discriminatory power as measured by the σ-Ferguson coefficient. This coefficient indicates the ability to differentiate respondents by the scoring system proposed in the study.

Test-retest reliability was measured with the help of the Pearson correlation coefficient applied to the results of the procedure carried out with a three-month interval. Cronbach's coefficient demonstrated a high level of one-time simultaneous reliability (Table 2).

Table 2. Indicators of the discriminatory power and the reliability of the test to determine the compliance of a primary school student with the rules in a normative situation

Scales	Discriminatory power (σ- Ferguson)	Reliability		
		One-time simultaneous reliability (Cronbach's α)	Retest reliability	
			R^*	Significance level (p)
Factor 1	0.84	0.934	0.875	0.01
Factor 2	0.90	0.910	0.885	0.01
Factor 3	0.82	0.857	0.869	0.01
Factor 4	0.83	0.896	0.926	0.01
Factor 5	0.85	0.810	0.894	0.01
Factor 6	0.82	0.761	0.807	0.01
Indicator of the cultural congruence of a primary school student	0.92	0.861	0.826	0.01

* Distribution by Kolmogorov-Smirnov is normal

We analyzed the reliability of the test by checking the consistency of every statement with the points scored in separate tables and in the test as a whole, as well as by examining the statistical reliability of differences between the top and the bottom of the sample measured by Student's t-test (Table 3). In this regard, answers to the majority of the statements reveal a reliable differentiation between the high and the low values in the sample.

Table 3. Indicators of the internal consistency of the test items to determine the compliance of a primary school student with the rules in a normative situation

Statements for parents to evaluate in order to assess their child's compliance with the rules	R1	R2	t-test
The pupil pronounces words correctly	0.376	0.764	3.098
The pupil does his or her homework	0.617	0.821	5.818
The pupil does not lie or cheat	0.761	0.819	8.060
The pupil obeys teachers	0.549	0.740	5.866
The pupil sits still	0.671	0.911	10.733
The pupil thinks before he or she does something	0.583	0.800	8.647
The pupil takes care of younger children	0.435	0.678	6.547
The pupil follows personal hygiene rules	0.545	0.622	5.710
The pupil gets good marks	0.441	0.831	4.315
The pupil does not call other children names	0.698	0.918	8.938
The pupil does not make noise	0.638	0.890	10.729
The pupil makes correct statements	0.320	0.819	3.468

Statements for parents to evaluate in order to assess their child's compliance with the rules	R1	R2	t-test
The pupil helps to clean up	0.271	0.843	3.562
The pupil makes his/her parents happy	0.334	0.606	5.152
The pupil plays together with other pupils without conflicts	0.637	0.898	8.699
The pupil thinks before he or she says something	0.634	0.823	7.155
The pupil does not miss lessons	0.325	0.785	5.862
The pupil does not leave home without permission	0.594	0.875	7.624
The pupil gets his or her school bag ready beforehand	0.731	0.909	13.856
The pupil develops his or her memory	0.606	0.857	12.063
The pupil does not offend other children	0.657	0.907	8.656
The pupil is obedient	0.627	0.616	5.634
The pupil is not late	0.577	0.774	6.220
The pupil sits upright	0.468	0.757	6.433
The pupil reads a lot	0.513	0.888	7.608
The pupil keeps his or her room tidy	0.344	0.914	5.400
The pupil keeps his or her promises	0.611	0.842	10.007
The pupil acts on his or her parents' instructions	0.604	0.732	5.418
The pupil does not intervene when adults are talking	0.482	0.712	4.804
The pupil helps his or her parents	0.220	0.816	3.180
The pupil does not make mistakes in his or her homework	0.634	0.810	8.605
The pupil comes home on time	0.573	0.845	9.508
The pupil does not fight	0.576	0.869	6.794
The pupil is literate	0.355	0.774	3.780
The pupil is attentive	0.593	0.809	9.678
The pupil shows respect for seniors	0.557	0.665	6.647

R1 (or the second column) gives coefficients of the linear correlation of an item with the total score (36 items); R2 (or the third column) presents coefficients of the linear correlation of an item with the internal scale of the subtest; the t-test (or the fourth column) reports for the item the level of the statistical reliability of differences in arithmetic averages (Student's t-test) between the top and the bottom of the sample (selected based on the value of the total score). The calculation was made on the basis of the normal distribution.

To determine the consistency of the test, we used the Spearman-Brown prediction formula and found the rate $r = 0.28$, which is significant at the level of $\alpha \leq 0.01$ for the sample of 61 respondents.

Discussion

The cultural congruence test — in its basic positions — is in line with the theoretical tenets of developmental psychology related to the evaluation of a primary school child. Learning, as the leading activity at this age, is critical in shaping new

psychological formations (Davydov, 1992; Elkonin, 1989; Talyzina, 1996) that are specifically reflected in three factors — academic competence, self-control, and self-service. These factors — in regard to construct validity — are in line with formations such as self-control, which are identified in the research literature. The factor regulation implies rules and restrictions imposed on the behavior of primary school students and is a key driver behind such new formations as arbitrariness. Adults are an integral part of the social setting for the development of a primary school student; they help the child internalize the culture (according to Vygotsky). Such factors as obedience and social interaction, which reflect the specific character of the age-specific normative situation, are in line with this theoretical tenet. The study reveals reflection as a major new function that determines the factors mentioned above. It is connected with the development by primary school students of the symbolic function, the ability to plan, and improved social interaction (Veraksa, 2006; Zack, 1981). The cultural congruence factors were positively checked against the theoretical tenets of psychology research, and this check confirmed test validity. Procedures related to the study of personality in culture have the potential to increase clarification. In this case, for example, in all cultures there are gender stereotypes and differences in the rules for boys and girls. There are differences in the rules for children living in mono-ethnic environments isolated from other ethnic groups. There are differences in the rules for children living in urban and rural areas. Therefore, research for constructing techniques to identify cultural congruence can be extended and refined. In this case the algorithm that we have developed and implemented while constructing the technique is most important for us; this algorithm includes the phenomenological assessment of rules peculiar to the given age — hereinafter, the frequency and factor analysis of the rules — and, in addition, the psychometric evaluation of reliability and validity.

Conclusion

Our cultural congruence test for primary school students consists of six factors based on age-specific rules inherent in normative situations: social interaction, academic competence, self-control, obedience, self-service, and regulation.

Psychometric assessment, among other aspects, is focused on consistency of the factors identified with the theoretical tenets of developmental psychology concerning primary school students. The theoretical substantiation of the technique is related to the position of Vygotsky (1928/1996, p. 335) in which culture "grows into the psyche of the child", with the means as instruments. In other words, the means are the instruments aimed at the possession of behavior acquired by children in their social interactions with adults. These cultural means are internalized and become an acquisition and internal resource of the psyche. Any rule worked out in a culture serves as a mental instrument. We do not limit the sphere of the child's rules to the school only because the social situation of development involves the greater sphere of interactions in which a child is involved. By interacting with parents and peers and other people, children will show their congruence with the rules or their incongruence. As was emphasized above, studies of the interactions of a child and a rule are almost devoid of works aimed at constructing valid and reliable techniques for identifying the congruence typical for this age. At the same time it is

incredibly important to assess the child's socialization and personal development. Low cultural congruence can be an indication of hyperactivity problems, which can occur when the rules are contained in the factors of self-control, self-service, and regulation. However, a high level of cultural congruence can be correlated with conformism and can have a negative correlation with creativity, as was observed in a study of preschool children (Bayanova, 2014). A test for identifying cultural congruence allows us to determine the level of compliance with the stable range of rules peculiar to a certain age and to the cultural context in which a child lives (Appendix A). This technique allows us to estimate the cultural congruence of primary school students living in Russia.

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Appendix. A cultural congruence test for primary school students

Please assess the behavior of [the designated] primary school student against the following statements (scores on a scale from 0 to 4):

0 – does not match
1 – does not quite match
2 – more or less matches
3 – matches in general
4 – fully matches

Please circle one of the numbers opposite each statement.

1	The pupil pronounces words correctly	0	1	2	3	4
2	The pupil does his or her homework	0	1	2	3	4
3	The pupil does not lie or cheat	0	1	2	3	4
4	The pupil obeys teachers	0	1	2	3	4
5	The pupil sits still	0	1	2	3	4
6	The pupil thinks before he or she does something	0	1	2	3	4
7	The pupil takes care of younger children	0	1	2	3	4
8	The pupil follows personal hygiene rules	0	1	2	3	4
9	The pupil gets good marks	0	1	2	3	4
10	The pupil does not call other children names	0	1	2	3	4
11	The pupil does not make noise	0	1	2	3	4
12	The pupil makes correct statements	0	1	2	3	4
13	The pupil helps to clean up	0	1	2	3	4
14	The pupil makes his/her parents happy	0	1	2	3	4
15	The pupil plays together with other students without conflicts	0	1	2	3	4
16	The pupil thinks before he or she says something	0	1	2	3	4
17	The pupil does not miss lessons	0	1	2	3	4
18	The pupil does not leave home without permission	0	1	2	3	4
19	The pupil gets his or her school bag ready beforehand	0	1	2	3	4
20	The pupil develops his or her memory	0	1	2	3	4
21	The pupil does not offend other children	0	1	2	3	4
22	The pupil is obedient	0	1	2	3	4
23	The pupil is not late	0	1	2	3	4
24	The pupil sits upright	0	1	2	3	4
25	The pupil reads a lot	0	1	2	3	4
26	The pupil keeps his or her room tidy	0	1	2	3	4
27	The pupil keeps his or her promises	0	1	2	3	4
28	The pupil acts on his or her parents' instructions	0	1	2	3	4
29	The pupil does not intervene when adults are talking	0	1	2	3	4
30	The pupil helps his or her parents	0	1	2	3	4
31	The pupil does not make mistakes in his or her homework	0	1	2	3	4
32	The pupil comes home on time	0	1	2	3	4
33	The pupil does not fight	0	1	2	3	4
34	The pupil is literate	0	1	2	3	4
35	The pupil is attentive	0	1	2	3	4
36	The pupil shows respect for seniors	0	1	2	3	4

Key:

Factor 1 – 3, 7, 10, 15, 21, 27, 33
Factor 2 – 1, 6, 12, 16, 20, 25, 34
Factor 3 – 5, 11, 19, 24, 29, 31, 35
Factor 4 – 4, 14, 18, 23, 28, 32, 36
Factor 5 – 8, 13, 26, 30
Factor 6 – 2, 9, 17, 22

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The connection of socio-demographic factors and child-parent relationships to the psychological aspects of children's development

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Preschool childhood is a time of rapid development. During this period a child`s interaction with significant adults plays a very important role. The parent, as a mediator, defines the "zone of proximal development" (Vygotsky, 1984). The common assumption is that to determine a parent's position, it is important to acknowledge both socio-demographic factors and the parameters which define the socio-psychological aspects of parent-child relationship. Hence, the type of research where a child's psychological development is studied in the context of the socio-demographic and socio-psychological factors which determine the social situation of development, is very promising.

Based on our previous research (Sobkin, Marich, 2002; Cheie, Veraksa, 2015), a program of experimental research intended to determine the interconnections between the socio-demographic and socio-psychological parameters of parent-child relationships, and the level of a child's psychic development, was designed. The research was based upon the material obtained through testing 59 children between 5 and 7 years old with specially collected psychological testing methods (Veraksa A.N. etc), as well as from the results of a special sociological questionnaire presented to their mothers (Sobkin V.S. etc). The research was carried out in 2014-2015 in municipal kindergartens of Moscow.

Among the socio-demographic factors analyzed, the most significant results were related to the child's gender, the family structure, and the mother's education. Thus, boys showed higher results on visual memory tests, and girls scored better on tests for self-control and social intelligence (higher ability to detect the reason for someone else's negative emotions). Children from single-parent families had better results on verbal memory tests, but scored lower on those for self-control. Also they had less ability for decentration. The differences in mothers' educational levels influenced the number and intensity of children's fears, as well as their inclinations to avoid fearsome situations.

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The analysis of features of the parenting position (such as attitude toward one's future, positive/negative emotional state during the interaction with the child, authoritative/democratic approach to upbringing) revealed two different strategies which children used to perform executive tasks.

Thus, the present research showed a significant degree of essential connections between socio-demographic factors and parent-child relationships to the specifics of a child's mental development.

Keywords: child development, preschool age, social situation of development, parent-child relationships, executive functions, social intelligence

Introduction

The cultural-historical activity theory states that the environment which surrounds a child is crucial to his/her development. Various factors of the social situation of development may enhance a child's mental development, or undermine it (Bozhovich, 2008; Dumitrashku, 1996; Elkoin, 1960; Lisina, 2009; Vygotsky, 1984; Zaporozhets, 1965; Kovan, Kovan, 1989). However, while researchers in the 1950-1970s focused more on the common tendencies and periodization of the formation of mental functions (Vygotsky, 1984; Lisina, 2009; Elkoin, 1960), nowadays attention has been shifted to the specific development of psychological functions at a certain age (Bjorklund, Kipp, 1996; Carlson, Moses, 2001; Smirnova, 1998; Sobkin, Skobeltsina, Ivanova, & Veryasova, 2013).

Preschool childhood is a time when a growing child develops rapidly. During this stage of life, mental processes become mediated and self-regulated, and the child's thinking undergoes decentration (Lisina, 2009; Elkoin, 1960; Vygotsky, 1984; Zaporozhets, 1965). According to L.S. Vygotsky (1984), the key role is played by an important adult who fulfills an intermediary function, defining the child's views of the world and determining their zone of proximal development.

Thus, research which complements the study of children's individual psychological features with a description of various factors in the child's social situation of development (socio-demographics, parent-child relationships) is very important both for theoretical and practical psychology. This kind of research is actively carried out abroad. Researchers analyze the connection between the developmental process and such socio-demographic factors as the parents' educational level, family structure, SES (socio-economic status), etc. Most of the research shows a significant correlation between the development of children's executive functions and the parents' level of education, housing conditions, and the presence of both parents in the household (Alarcón-Rubio, Sánchez-Medina, & Prieto-García, 2014; Anastasy, 1956; Ardila, Rosselli, Matute, & Guajardo, 2005; Belmont, Marolla, 1973; Bulgarelli, Molina, 2016; Filippetti, Richaud, 2012; Fitzpatrick, McKinnon, Blair, & Willoughby, 2014; Sarsour, Sheridan, Jutte, Nuru-Jeter, Hinshaw, & Boyce, 2010; Willoughby, Wirth, Blair & The Family Life Project Investigators, 2012).

Plenty of research deals with parenting and the way it relates to the development of child's executive functioning. Most focuses on the effect that the maternal parenting style and supportive behavior have on preschoolers' executive functions

and problem solving (Blair, Raver, Berry, & Family Life Project Investigators, 2014; Hammond, Müller, Carpendale, Bibok, & Liebermann-Finestone, 2012; Leerkes, Blankson, O'Brien, Calkins, & Marcovitch, 2011; Lucassen et al., 2015; Matte-Gagné, & Bernier, 2011; Ursache, Blair, Stifter, & Voegtline, 2013). This can be understood in relation to the time that parents spend with their children: in the vast majority of families, mothers still spend more time taking care of their children than fathers do. Thus, Roskam, Stievenart, Meunier & Noel (2014) showed that both mothers and fathers contribute through their child-rearing behavior to their children's executive functioning, but the mothers' effect on children's development of inhibition was more pronounced than that of the fathers.

In some of the Russian studies, the specific characteristics of a child's development are also associated with his/her family's socio-demographic parameters and his/her parents' upbringing style (Andreeva, 1994; Chernov, 2009; Dumitrashku, 1996; Kochetova, 2012; Smirnova, Sobkin, Asadulina, & Novakovskaya, 1999; Sobkin et al., 2013). In one of our previous studies (Sobkin, Marich, 2002), the difference between the cognitive and emotional development of boys and girls living in one-parent families was revealed. However, in this research we used the Venger test for cognitive development and a picture test for emotional perception of the family; therefore it is quite difficult to compare the results of this work with modern investigations done abroad.

Lately the NEPSY-II set of neuropsychological tests has become rather commonly used for studies of preschool children's mental development (Korkman, 1999; Korkman, Kirk & Kemp, 2007; Visu-Petra, Cheie, Benga, & Miclea, 2012). For example, this battery was used in a cross-cultural study of Romanian and Russian preschool children (Cheie, Veraksa, Zinchenko, Gorovaya, & Visu-Petra, 2015). It showed a difference between children's levels of anxiety in these countries, which the authors interpreted as an important factor in the development of executive functions in children between 5 and 7 years of age.

In general, analysis of the literature allows us to conclude that in the field of child development, a special line of psychological research has been developed which includes analysis of both the socio-psychological and the socio-demographic parameters that characterize a child's social situation of development. However, the specific interrelationships between socio-demographic factors, parent-child relationships, and particular features of the child's mental development are yet to be studied and clarified. The present study was carried out to pursue these relationships.

Method

Sample

The basis for this article is material obtained through psychological testing of children between 5 and 7 years of age in municipal kindergartens in Moscow, as well as the results of a questionnaire filled out by their parents. Mothers were more likely to respond (due to the fact that some of the families were single-parent, and some of the fathers refused to participate). In this regard we selected results from 59 children whose mothers also took part in the investigation.

Research methods

Researchers from the Center for Sociology of Education (dir. V.S. Sobkin) for the Russian Academy of Education, in partnership with a study group of the faculty of psychology at Lomonosov Moscow State University (dir. A.N. Veraksa), have prepared a research program designed to compare the socio-demographic factors and the psychological aspects of parent-child relationships, with the characteristics of children's mental development. To achieve this goal, the design of the research included testing of preschool children and a sociological questionnaire for their parents.

According to the research program, a set of methods was selected to describe various aspects of an older pre-school child's mental development.

The majority of these methods are Russian versions of subtests from the neuropsychological complex NEPSY-II, which is designed to evaluate the mental development of children between 3 and 16 years old (Korkman, 1999; Korkman et al., 2007). According to the authors of this complex, it is based on the cultural-historical activity theory largely represented in the works of A.R. Luria. Previous research had shown the possibility of using these methods on the Russian children (Cheie et al., 2015). The selected subtests were complemented by a number of additional methods widely used outside Russia. This allowed the creation of a new testing program for older pre-school children, which includes three complementary methods designed to measure social intelligence, cognitive development, and the development of executive functions.

The first module is intended to diagnose the child's level of social and emotional intelligence. It includes the following methods: Theory of Mind, Affect Recognition, Test of Emotion Comprehension, and Picture Anxiety Test.

Theory of Mind (NEPSY-II) is intended to measure the child's ability to analyze situations and interpret another person`s thoughts and feelings.

Affect Recognition (NEPSY-II) is designed to measure the child's ability to detect emotions by facial expressions (joy, sadness, calm, fear, anger, revulsion).

The Test of Emotion Comprehension (TEC) (Pons, Harris, 2000; Pons, Harris, & de Rosnay, 2004) is designed to evaluate how well children understand various emotions which may show up in different situations, and how they understand their causes.

The Picture Anxiety Test (PAT) (Dubi, Schneider, 2009; Dubi, Schneider, & Lavellee, 2012) allows us to measure the level of a child`s fear, and the degree of his/her inclination to avoid typically fearsome situations.

The second module is dedicated to the study of the child's cognitive level, memory, and learning ability. It includes such methods as the colored Raven's Progressive Matrices, Memory for Designs, and Sentence Repetition.

Raven's Progressive Matrices (Raven, Raven, & Court, 1998) are widely known and used to measure a child`s nonverbal intelligence.

Memory for Designs (NEPSY-II) was used to measure the level of development of visual memory and a child's ability to memorize integral configurations of objects and details of images.

Sentences Repetition (NEPSY-II) measures a child`s ability to perceive, store, and reproduce verbal information.

The third module includes methods that allow us to diagnose the level of development of executive functions and cognitive flexibility: namely, the Inhibition test and Dimensional Change Card Sort.

The Inhibition test (NEPSY-II) was used to measure the level of the child`s development of executive functions.

The Dimensional Change Card Sort (DCCS) (Zelazo, 2006) is dedicated to measuring the child's ability to regulate his/her behavior according to complex rules, which allows the child to evaluate his/her level of self-control and cognitive flexibility.

A special questionnaire was used for the mothers` survey. It was developed by the research group of the Center for the Sociology of Education of IME RAE, and includes 100 questions which evaluate various aspects of a preschool child`s life (Sobkin, & Marich, 2002; Sobkin, & Skobeltsina, 2011; Sobkin, Skobeltsina, & Ivanova, 2011; Sobkin, Skobeltsina 2015). We picked only those questions which allow us to characterize the child's social situation of development. Firstly, we used questions concerning socio-demographic factors (the child's gender, family structure, mother's educational level). Secondly, we picked questions about the interaction between mother and child, and the style of communication (authoritarian/democratic).

The whole set of tasks was split up and carried out over three meetings, each 20-25 minutes long. The parents were given the questionnaires which they could fill out at home in their spare time.

While planning the research program, we suggested that there is a connection between child`s success at given tasks and the parameters of his social situation of development as indicated in the questionnaire.

During the processing and analysis of the data, we used average values based on raw data points, since the norms for the applied psychological methods have not yet been completely adopted in Russia.

Results

The data we received is presented in two parts. The first part is dedicated to analyzing the connection between children's levels of development and such socio-stratifying and demographic factors as gender, family structure, and the mothers' level of education. The second part deals with the connection of the children's level of development to features of the mother's attitude toward life and parenting strategy: the parenting style (authoritarian/democratic), comprehension of the future (optimism/doubt), and the mother's emotional state during interaction with the child (positive/negative).

The influence of socio-stratifying factors on the child's mental development

Gender differences. The data we obtained showed that boys are better at memorizing visual information (Memory for Designs method). A statistically significant difference appears in the 4th test: 22.3 points for boys and 17.9 for girls ($p \leq .04$). This test is notable because it is secondary, i.e. the child is offered the same configu-

ration of cards twice. The successful passing of the 4th test may be a sign that boys have higher ability to use previous experience and higher learning ability.

At the same time, girls show higher results in the Dimensional Change Card Sort (DCCS) in the task with "borders" (8.2 and 6.3 respectively; $p \leq .05$). In this task children are asked to sort cards first by one parameter (color), then by another (shape). After the child grasps the rules for sorting, he/she is offered a 3rd more complicated task with "borders," where the rule calls for sorting cards by one or another parameter depending on additional information (frame on the cards). Thus, girls' more successful implementation of this harder task indicates their higher cognitive flexibility.

Furthermore, differences between boys and girls were detected through the second method, Inhibition, designed to diagnose the development of executive functions. Children are given two lists of pictures: the first had figures (circles and rectangles), the second had arrows (up and down). Both lists included two tests: "naming" and "inhibition." In the test for "naming," a child had to name the figures (circle/rectangle) and the direction of arrows (up/down) which are shown in the picture. The second test ("inhibition") required naming figures and directions of arrows opposite to those which were actually pictured in the picture (i.e. instead of the pictured circle, say, "rectangle").

In these tasks boys made more mistakes in the tests for naming figures than girls (4.0 and 2.2 respectively; $p \leq .05$) and made more corrections (2.0 and 0.9 respectively; $p \leq .01$). Thus, boys were less attentive and careful while performing this task, so they had to correct themselves more . In the tests for inhibition with arrows (children were asked to name directions of arrows opposite to those which were actually pictured), boys had a larger number of mistakes in general (10.6 and 6.8 respectively; $p \leq .04$), as well as more uncorrected mistakes (8.2 and 4.3 respectively; $p \leq .04$). This was the final task presented by this method; thus the increased number of mistakes may indicate that boys tire more quickly, consequently making more mistakes and correcting them less effectively.

The results from the methods that evaluate executive functions show that girls display better self-control than boys; they are more attentive in completing tasks, and are able to follow difficult rules and stay focused for a longer period of time.

Tests for emotion recognition (Affect Recognition method) also presented a range of significant differences (*Figure 1*). In these tests, the top of the page displayed a child in a certain emotional state, and below were pictures of four other children showing different emotions. The participant was asked to point out which one of the children displayed below was feeling the same way as the child at the top of the page. The percentage of girls who correctly indicated sadness ($p \leq .04$) and neutrality ($p \leq .01$) was higher than that of the boys. The boys were better in recognizing anger ($p \leq .03$).

These differences may be explained by culturally determined parenting strategies for both genders: boys are traditionally forbidden to display sadness, while for girls it is socially acceptable (Kon, 2003). At the same time, girls are not allowed to show anger, while for boys, who are by and large the ones who take part in conflicts and fights with peers, this emotion is considered more essential; sometimes they are even encouraged to express this feeling.

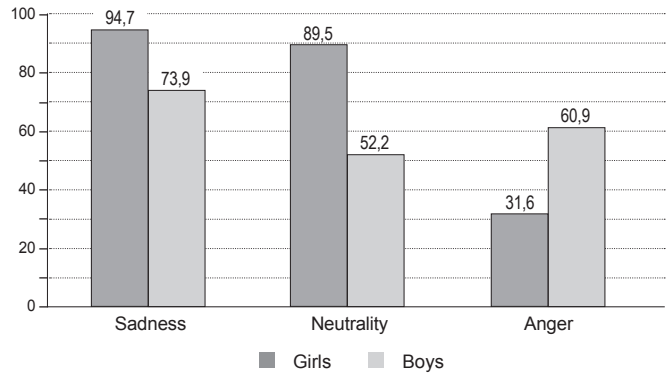

Figure 1. Gender differences in correct recognition of various emotions (%)

Obvious gender differences were found in task No. 5 of the Theory of Mind method. This task requires the child to answer which one of three girls gets to hug dolphins in real life: Annie, who lives by the ocean, and whose dad lets her swim with dolphins; Olya, who had a dream last night about hugging a dolphin; or Lisa, who likes to read about dolphins. The results showed that girls show better results than boys on this task (71.4% and 32.1% respectively; $p \leq .01$). Thus, girls are more successful in tasks which require separation of various contexts: a dream, a fantasy, and reality.

In addition, girls also are more successful at task No. 7 of this method. This task includes the following story: "Vanya is not good at writing. He failed the writing test at school. Mom tells Vanya: `You'll feel better if you go to play with Lera.' Vanya went to visit Lera. She offered to play a word game. Vanya didn't play with Lera and went back home. Why?" Most girls were able to identify the reason for his rejection (47.6% for girls and 20.0% for boys; $p \leq .05$). Thus, the results of this test show that girls are better at identifying the reason for someone else's negative emotions.

In general, the results of these tasks for boys and girls allowed us to discover a few notable gender differences. Boys have higher learning ability, while girls display better cognitive flexibility and self-control. Also, girls have higher social intelligence: they better understand social contexts corresponding to various situations, and are able to identify the reasons for someone else's negative emotions more correctly.

Family structure (two-/one-parent family). The results we obtained revealed a few significant differences according to various methods of analysis.

Children from one-parent families do better on the verbal memory test (Sentence Repetition) where a child has to repeat sentences after the examiner. Among the 17 sentences used in this method, children from single-parent families completed one third of the tasks much better than children from two-parent families ($p \leq .05$). Generally, this result indicates a higher level of verbal memory.

On the other hand, in the Inhibition test, children from one-parent families did worse in correcting their mistakes in all four tasks than children from two-parent families (this tendency shows in all tests: "naming" and "inhibition"; $p \leq .05$). This result allows us to conclude that children of single-parent families have less self-control.

Additionally, family structure has its influence on the child's emotional intelligence. According to the Theory of Mind test, children from single-parent families

do worse on task No. 1, where a child is told the following story: "When Andrey opened a cookie box, he saw that Mom had put pasta inside it. He got upset and put the box back in its place. When Andrey's brother came in, he saw a cookie box. What do you think Andrey's brother thought was in the box?" The majority of the children from one-parent families failed the task as compared to those from two-parent families (55.6% and 18.9% respectively; $p \leq .03$). These children usually answered that in the brother's view the box contained pasta, which means it is harder for them to imagine how another person sees a situation, and to put themselves into their shoes.

Thus, the data we obtained shows that the absence of one of the parents (father) has a negative impact on the development of self-control and social intelligence.

Family structure (having a sibling or not). We divided the sample into two parts based on the number of children in the family: one child or two.

Children with a sibling get higher scores in the 4th test of the method for visual memory (Memory for Designs) compared to those who have no sibling (22.3 and 17.6 respectively; $p \leq .03$). From these particular results, it can be concluded that children who are brought up with siblings have a higher level of learning ability.

At the same time children with siblings make more mistakes in naming figures from the Inhibition method (4.0 and 2.1 respectively; $p \leq .04$); consequently they have a larger percent of self-corrections on this task (2.0 and 0.9 respectively; $p \leq .01$). These results indicate that children with siblings show a lower attention span compared to those who are the only children in a family. In the test of inhibition with arrows, children with a sibling are more inclined to correct their mistakes (3.0 and 1.8 respectively; $p \leq .05$), which indicates their high level of self-control.

By this means, the given results show that the number of children in a family is an important factor influencing children's development and impacting their learning ability and self-control.

Mother's level of education. In the analysis we established two groups: the first group included children whose mothers had higher education; the second included those whose mothers had secondary level, dual, or incomplete higher education. Comparison of these two groups revealed crucial differences concerning the number and intensity of children's fears.

For example, children whose mothers have no higher education show emotional problems through the Picture Anxiety Test (PAT); they have more fears of higher intensity than children whose mothers have higher education (19.1 and 10.7 respectively; $p \leq .02$). Moreover, children whose mothers have lower educational status are more inclined to avoid fearsome situations (17.5 and 8.9 respectively; $p \leq .01$).

Additional analysis revealed certain situations where these differences in intensity of fears among children whose mothers had different educational background came out (*Table 1*). Namely, children whose mothers had no higher education had more intense fears of the following situations: a doctor's appointment, fireworks, fancy dressed people, and elevator rides. Additionally, they have more intense social fears, such as fear of performing in front of a group of children, and fear of making the acquaintance of peers at a playground; it is more difficult for them to overcome negative (anxious) thoughts; they worry more often about whether they are doing everything right.

Table 1. Differences in intensity of fears among children whose mothers had different educational background

Fearsome situation	Mother's level of education		P
	Higher education	Secondary level, dual or incomplete higher education	
Doctor's appointment	0.5	1.4	≤ 0.01
Fireworks	0.1	0.6	≤ 0.03
Fancy dressed people	0.6	1.5	≤ 0.02
Elevator rides	0.3	1.4	≤ 0.002
Fear of performing in front of a group of children	0.1	0.8	≤ 0.001
Fear of making the acquaintance of peers at a playground	0.1	0.6	≤ 0.01
Overcome negative (anxious) thoughts	0.2	1.1	≤ 0.002
Worrying about doing everything right	0.3	0.9	≤ 0.05

The majority of the aforementioned fearsome situations are connected with differences in the child's social experiences. We may suppose that parents with higher education help their children obtain a wider and more positive experience of social interaction, and thus the situations above are not so "unusual" (worrisome) for them. It is also reasonable to assume that higher education defines a higher social status for a mother and allows her to be more confident and calm in numerous situations, especially those where she and her child are faced with various social institutions (for example, medical center, kindergarten). Mothers without higher education have lower status, which causes insecurity during social interactions with other people — which insecurity is passed on to their children.

Thus, the research revealed a significant influence of the mother's educational status on the child's emotional well-being. But at the same time, it should be noted that there were no evident differences in the implementation of various tasks by children from families with different financial status. This may be due to the fact that the majority of participants identified themselves as from a middle-income stratum.

To sum up this part of the article, we conclude that the research reveals a wide range of very important tendencies reflecting the impact of different socio-demographic and socio-stratifying factors on the child development.

Correlation between the psychological aspects of parent-child relationship and the specific course of child development

In this part we will discuss how the psychological aspects of mother-child interaction may influence the preschool child's development.

In this research we focused on the system of family relationships on the microlevel of social interaction using the ecological concept of U. Bronfenbrenner (1979). Hence we will analyze such socio-psychological aspects of the maternal position as her emotional state during interaction with the child and her parenting style. In addition to these two aspects, we will also consider the influence of a mother's sense of

social well-being (optimism or doubts about the future) on the child's development. We may hypothesize that these three aspects play an important role in defining the unique social situation of development at the preschool age.

Attitude toward life's perspectives (optimism/doubt). The question about future perspectives included in the parent questionnaire allowed us to distinguish two groups: the first included mothers who "look ahead optimistically and confidently;" the second included those who "have doubts that their life will proceed successfully." Differences in implementation of various tasks will be considered among children from each of these two groups. Our analysis proved that these differences are connected with levels of success in two tasks: executive functioning and emotion comprehension.

Children whose mothers doubt their future prospects more often correct themselves in the inhibition task within the Inhibition method: in the set with figures (3.6 and 1.7 corrections respectively; $p \leq .01$), as well as in the set with arrows (3.8 and 2.3 corrections respectively; $p \leq .04$). This result indicates that these children have a higher level of self-control, because after making a mistake, they are inclined to stop and correct it. On the other hand, the children of optimistic mothers complete this task much *faster* (57.5 and 62.4 seconds respectively; $p \leq .05$), but again, do not tend to correct their mistakes. They are evidently more self-assured and confident. Generally, the differences we found allow us to define two strategies toward implementing tasks, depending on the mother's future expectations. The first strategy consists of quick and confident completion of the tasks and the child`s confidence of success. The second implies slower processing of the tasks and correction of mistakes.

As for the task of emotion comprehension (TEC), the results showed that children of mothers who are optimistic about their future do better in a task which requires analyzing situations with contradictory motives. These tasks are connected with making the moral choice, and the emotions which children can feel faced with such a choice. For example: In one situation the child wants to eat a cookie, but holds back because he/she did not ask permission. In another, the child eats the cookie, but does not tell his/her mother about this. The child's emotions as a result the two different actions — to eat a cookie without permission or not? To tell mother about the misconduct or not? — were what the child was asked to analyze.

Results showed that children of optimistic mothers tend to feel more positive in the situations where they follow the rules (the child holds him/herself back and is glad that he/she did not eat the cookie without permission), and get upset after breaking them (child is upset for not having told his mother about this misconduct). Thus, the research shows the profitable influence of the mothers` positive attitude toward the future (optimism in future evaluation) on the moral regulation of child's behavior: children of optimistic mothers can more easily submit to social norms and feel good in the case of rules compliance. A different kind of reaction can be seen among children whose mothers "doubt" their future success: these children do not feel negatively about breaking the rules.

Thus, our research showed that the attitude of mothers toward their future success (optimism/doubt) is strongly connected both to the child's strategy in completing tasks (self-control) and to his/her attitude toward moral norms (positive

reaction about compliance with them). Generally, the results correspond with the notions of L.S. Vygotsky about the role of an adult as a mediator who defines the zone of child`s proximal development. In partnership with an adult — more specifically, an emotionally positive adult — the child forms a very important feature of behavior control — the absence of fear of making mistakes.

*Mother`s emotional state during interaction with the child (positive/negative).* Analysis of the mothers` answers to the question about their emotional state during interaction with their children allowed us to distinguish two groups. The first included those who describe their communication with the child in a positive way: "I feel happy," "I feel joy and a rush of energy." Those who feel negatively formed the second group: "Communication with my child is full of difficulties which turn into scandals," "I cannot handle his/her spontaneous activity," "I am annoyed and irritated."

We found the differences shown the successful implementation of the Inhibition method tasks similar to the ones in the case of the perspective toward life. The children whose mothers are positive about communication with them complete the inhibition task with figures much more quickly (56.0 and 63.4 seconds.; $p \leq .01$). The speed of implementation of this task reveals the level of the ability to control one's cognitive processes and inhibit spontaneous reactions (cognitive flexibility). Children whose mothers are negative about interaction with them have a higher rate of self-corrections in the inhibition task with arrows (3.3 and 1.9; $p \leq .05$).

Thus, the data we obtained shows that self-control is better developed among children whose mothers are mostly negative about communication with their children. In our point of view, this child`s attitude (thoroughness, attempts to correct a mistake and complete the task correctly, even though a bit more slowly) may be connected to his/her wish to avoid a negative emotional reaction of an adult to a mistake.

Mother's parenting style (authoritarian/democratic). As to the connection between the parenting style adopted by the mother and the child's development, we will compare two styles based on the mothers' most common answers to the questionnaire, which we interpret as authoritarian and democratic. The authoritarian style implies unconditional submission of a child to the authority of an adult ("I believe that the child must fulfill his/her responsibilities and obey adults"), and the democratic style admits the child`s right to have his/her own opinion, independent action, and self-expression ("I believe that the child should have the possibility to freely express his/her emotions and opinion on any subject"). The research showed a difference between implementation of Inhibition and DCCS tasks depending on the mother's parenting style.

Children of authoritarian mothers were more successful in the DCCS task which required sorting cards according to one simple parameter (color) than children of democratic mothers (6.0 and 5.7 respectively; $p=0{,}005$). Considering the fact that this task is an easy one, we suppose that children of democratic mothers tend to hurry while doing it, and children of authoritarian mothers pay more attention, as they are used to strict control and try to avoid mistakes.

Furthermore, we found a tendency toward quicker implementation by children of mothers with a democratic parenting style (34.2 and 36.9 seconds; $p \leq .02$) in the task of naming figures within the Inhibition method. At the same time they leave more uncorrected mistakes (3.1 and 1.3 mistakes; $p \leq .05$). The same tendency

showed up in the inhibition test with figures: children of mothers with a democratic parenting style leave more uncorrected mistakes in this task (5.5 and 2.8 respectively; $p \leq .04$).

The differences found by in our two methods indicate that children of democratic mothers tend to be more impulsive; they try to complete the task quicker and at the same time let themselves make mistakes. On the other hand, children of more authoritarian mothers tend to correct their mistakes, which slows the speed of the task implementation. These facts allow us to assume that among children of more authoritarian mothers, a mistake has a higher emotional value ("fear of making a mistake").

To sum up the material from this part, we would like to emphasize that the influence of all the mentioned aspects (the mother's attitude toward life`s perspectives, her emotional state during interaction with the child, and her parenting style) shows up largely in the tasks for inhibition and self-control. It results in two different behavioral strategies of a child toward completing these tasks. The first strategy is to reach the quickest result with less attention to its quality (lack of mistakes). It is connected with such aspects as mother's optimistic attitude toward her future, her positive state during interaction with the child, and her democratic parenting style. The second strategy is to correct mistakes, while taking longer to complete the task. This strategy is connected with mother's doubts about her future success, negative emotions towards communication with the child, and an authoritarian parenting style.

We assumed that the aspects which characterize the mother's position are interconnected (*Figure 2*). Indeed, our analysis showed that mothers who doubt their future generally adopt the authoritarian parenting style, compared to those who are optimistic. Also they face more difficulties in interaction with their child and almost never feel happiness. Furthermore, mothers with a democratic parenting style more often indicate positive emotions (61.9% and 31.3%).

Hence, the regular appearance of the two detected strategies of child behavior in the tasks for inhibition is not accidental. It allows us to conclude that the child`s development of executive functioning is influenced by the complex of the mother's values, and emotional and behavioral outlook.

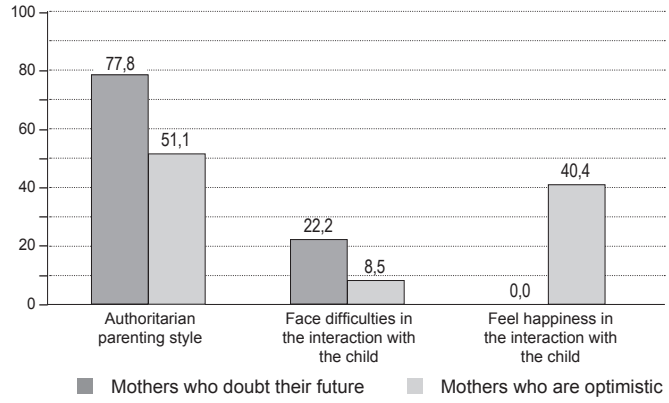

Figure 2. Interconnection between various aspects of mother's attitude (%)

So, based on the data obtained, we find that the more positive relationships (optimism, democratic parenting style, and positive emotional background) form a supportive environment for developing confidence in a child; such children usually aim at quick success. On the other hand, a negative relationship (mother's doubts about future success, an authoritarian parenting style, and negative emotions during interaction with the child) motivates a child to avoid failure. It influences the development of self-control.

Conclusion

Nowadays the notion of the "social situation of development" is interpreted in different ways, although, according to L.S. Vygotsky, this term specifically describes a certain relationship between a child and significant adults. Our research showed that using this term requires acknowledging a whole set of factors which determine child development.

In this work we studied the interconnection between the specifics of the social situation of development, such as socio-demographic factors and the parent-child relationship, and the development of mental functioning in preschool age children.

For instance, an important role is played by gender and various socio-stratifying factors (mother's educational level, family structure). We found a connection between socio-demographic factors and the development of preschooler's intellectual and emotional spheres. The most important result revealed was the connection between mother's educational level and the quantity and intensity of child's fears.

But the main idea which we would like to emphasize is the specific influence of mother-child relationships — such as the mother's attitude toward life, her emotional state, and her parenting style — on the development of preschool children. Our analysis showed the interrelationship between these features of the mother-child relationship, and the strategy her child uses while performing executive function tasks, which show his/her ability for self-control and regulation of his/her behavior and cognitive processes. Additionally, we assume here that we are dealing with a complex of interconnected factors of parenting which influence the child's choice of behavioral strategy, which is either seeking success or avoiding failure.

The results of the current study, therefore, confirm previous conclusions that maternal positive parenting is among the strongest predictors of children's EF (executive function), but also provide some new associations between aspects of the social environment and peculiarities of child's mental and emotional development. These results are of great practical importance, considering that both classical and modern research consider the development of executive functions as the crucial factor in a child's readiness for school, and a precondition for his/her future academic progress.

Limitations

The main limitation of this research is the number of participants. The small sample size led to difficulties in conducting statistical analysis: some of the socio-demographical groups couldn`t be compared, and there is a possibility that some of the differences couldn`t be shown.

Furthermore, we didn`t analyze the correlations between child development and the father`s answers, which could have enriched our interpretations and supplemented the results.

Moreover, it should be noted that statistical norms of task implementation for Russia haven`t yet been developed, which complicates the analysis of the results. In the future the authors intend to increase the sample, as well as find new ways of data processing, to create norms and continue the work with standardized methods.

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The zone of proximal development during assessment of intellectual development in pre-school children

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The zone of proximal development is a well-known and frequently referenced term within cultural historical psychology. Nevertheless, it is rarely used in the concrete practice of assessing intellectual development. The majority of proposals for such assessment are based on a behavioral and psychometric conception of development. This study presents a Scheme for Evaluation of Intellectual Development based on the concept of the zone of proximal development and on gradual intellectual development. The Scheme was applied to 160 Mexican pre-school children from rural, suburban, official, and private kindergartens. The Scheme permitted us to determine the zone of proximal development by evaluating the children's level of external orientation during the solution of new intellectual tasks. Three levels of orientation through external help were established. The results showed that the majority of children from all groups managed to fulfil new tasks after receiving external help, which indicated the existence of their zone of proximal development. Differences were detected in the use of the level of help in all groups. Statistical analysis showed a significant correlation between the level of helping received, the degree of fulfilment of the task, and the children's socio-cultural group. The results permitted us to establish more precisely the zone of proximal development at pre-school age. We discuss how the concept of the zone of proximal development might be used in concrete psychological practice and research, instead of being only a well-known term at a declarative level.

Keywords: intellectual development, zone of proximal development, level of development, preschool development, assessment of intellect, assessment of development, intellectual actions

Introduction

Prominent psychologist L.S. Vygotsky (1991) proposed the concept of the zone of proximal development in the third decade of 20th century. However, it was only years afterward that some psychologists began to elaborate concrete proposals for understanding this concept by presenting new cognitive tasks to children and adolescents (Feuerstein, 1979). There are still very few studies that apply this concept

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for diagnosing children's intellectual development. The majority of intellectual tests provide no help or orientation during the evaluation procedure, and are based on assessment of the possibility or impossibility of the child's achieving a solution, or answering a question, as in WISC tests (Weschler, 1987). The use and citation of such tests have become an undeclared prerequisite for publication in prestigious psychological and clinical journals. Any other kind of proposal for qualitative or interventional assessment within psychology and neuropsychology is normally strongly criticized, and misunderstood. Behind the usage of psychometrical tests, one possibly finds the conception that cognitive abilities are inherited. Orientation or external help for the child makes no sense, if the research goal is evaluating static (inherited, unchangeable) features of intellect based on the normal statistical distribution inside each population, with norms for each chronological age.

Another conception of development was expressed by psychologists such as Piaget (1973), Wallon (1942), and Zaporozhets (1986), who have studied the process of intellectual ontogenetic development in depth. Two particular lines of development have been identified in this process: functional (quantitative) development, and development by stages or forms (qualitative intellectual development) (Zaporozhets, 1986).

The time line of functional development shows enrichment of the content of the child's thinking — that is, acquisition of new actions and the gradual interiorization of these actions (Galperin, 1998; Obukhova, 1995; Talyzina, 1984). According to Zaporozhets (1996), changes in the content of the intellect are carried out along with the reorganization of levels (stages) of intellect. The important characteristic shown in the time line of the child's qualitative intellectual development is the appearance of new forms or levels of intellectual activity.

These forms or stages of intellect are: 1) the stage of concrete actions; 2) the stage of concrete images, or perceptive level; and 3) the stage of logical-verbal intellect (Zaporozhets, 1996; Elkonin, 1989, 1995; Poddyakov, 1977, 1996). At the stage of concrete actions, a child operates with real objects. At the stage of concrete images, a child fulfills cognitive tasks with representations of objects. At the stage of logical-verbal intellect, a child operates on the verbal level with no need for any kind of representation. Such an understanding of stages or forms of intellectual development might be enriched by including the stage of materialized actions, a stage at which a child may fulfill intellectual actions with external symbols or substitutions for real objects (Salmina, 1984; Talyzina, 2002). A similar stage might be found at the perceptive level, when a child doesn't operate with concrete representations, but with symbolic representations or schemes. In this case, the forms of possible realization of intellectual tasks might be as follows: concrete or material actions; materialized external actions; perceptive concrete actions; perceptive symbolic actions; and verbal (oral, written or completely inner) actions. It is important to note that the actions might be practical, repetitive, and communicative at all these levels.

In this study we used only the possibility of fulfilling intellectual tasks which might be considered solving problems. Intellectual problems always require previous analysis of initial conditions, synthesis of the essential features of the problem, and later generalization of the possibility of transferring the action to similar new conditions (Rubinstein, 1989). Galperin (1998) and Davydov (2000) also consid-

ered generalization an important feature of acquired intellectual action. We may assume that actions which do not require previous analysis of initial conditions, synthesis, and generalization, cannot be part of the class of intellectual actions.

The existence of quantitative and qualitative lines of intellectual development means that it is necessary to create diagnostic methods for both (Karpov & Talyzina, 1986; Talyzina & Karpov, 1987). The functional or quantitative line is used in the majority of psychological or psychometrical tests (Weschler, 1987). Such methods of evaluation of the level of children's intellectual development are being strongly criticized by many modern authors (Sternberg, 1985; Gardner, 1996). To use Vygotsky's terms (1991), such tests can only evaluate the zone of *actual* development, or the level of the child's actual knowledge or habits.

The evaluation of the qualitative line of intellectual development reveals another dimension. Russian psychologists who subscribe to the historical and cultural conception of development, have made the most significant efforts along this path in previous years (Talyzina & Karpov, 1987; Karpov & Taliizna, 1989). Our own research in this area represents a continuation of that orientation (Solovieva & Talyzina, 2002; Solovieva & Quintanar, 2004, 2012; Solovieva, 2004, 2014; Solovieva & Cols., 2013). We have designed and had approved a special method for diagnosing the intellectual development of pre-school and school children. This proposal is based on two theoretical principles: the social genesis of psychological functions (Vygotsky, 1982), and activity theory (Leontiev, 1975).

According to this approach, the evaluation of intellectual development means determining at what stage a child can realize a new task, and/or at what stage he or she can accept the orientation of the adult. Such orientation could be provided at different levels (proceeding step by step), using operations which conform to the action (Solovieva, 1999). Such steps of helping are broadly used in programs of correction in the modern child neuropsychology of Luria's school (Pylayeva & Akhutina, 1997) and pedagogical psychology (Salmina & Filimonova, 2001, 2010). The orientation might be presented at any point in the development of actions: concrete, materialized, perceptive, perceptive symbolic, or verbal.

The purpose of the present study is to propose a new way of diagnosing the intellectual development of pre-school children, which may be used in psychological practice and research instead of psychometric quantitative assessment. Our proposal is based on the use of gradual orientation, or help, for a child to fulfill new intellectual tasks, instead of assessing known or developed abilities. The concept of the zone of proximal development for new intellectual actions which are presented to the child in a situation of collaboration with an adult, includes two main aspects: 1) the stage at which a child acts after working with the orientation provided by an adult, and 2) the amount of this orientation offered by the researcher.

Method

Subjects

160 pre-school Mexican children of both sexes from kindergartens in the State of Puebla were selected. The age of the children was between 5 and 6 years (there were no children younger than 5 years old, nor children older than 6 years). There were no statistical differences between average age in the groups, which was 5.6.

The children were divided into four groups according to their social status. Group 1 included 40 children from a rural zone. Group 2 was comprised of 40 children from a suburban zone. Group 3 included 40 children from a lower-income urban zone. Group 4 consisted of 40 children from a higher-income urban zone (private kindergartens). All children attended official preschool Mexican institutions and were regular pupils. The distribution of groups by social level (rural, suburban, urban, and private) was accomplished by applying the educational institutions' official system of classification of social zones determined by formal living conditions.

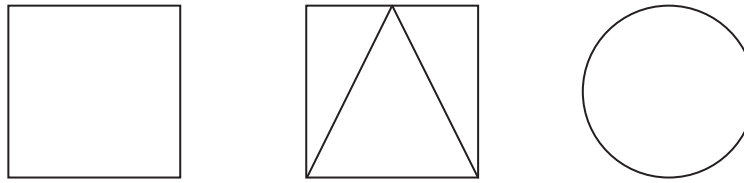
Procedure

The Scheme for Evaluation of Intellectual Development (Solovieva, 2004) has been applied. The Scheme does not precisely evaluate the zone of actual development of a child. The objective is to characterize the zone of proximal development according to the potential fulfillment of new intellectual actions on a materialized, perceptive, or verbal level. We understand determination of the zone of proximal development to mean establishing how co-operation with an adult helps a child solve a new problem, and at which level of action this new accomplishment might be realized. The fact that the task is new for a child is an essential part of the evaluation. Only the formative experiment permits us to determine the zone of proximal development (Vygotsky, 1991; Davydov, 1988; Talyzina, 1998). So, the Scheme evaluates the qualitative characteristics of the child's intellectual development in his/her zone of proximal development. The Scheme allows us to determine the stage of realization of the new action, after proposed orientation at the same stage (for, instance, stage of concrete actions or perceptive actions) and establishes the amount of help needed during this orientation.

An assessment of intellectual development by the presentation of new cognitive tasks with an external orientation for the solution was administered to all the children. First, the researcher verifies whether the task is new for the child or not. If the task is new, the orientation base of action (Talyzina, 1984) was provided. At the stage of elaboration of the orientation base of action, the researcher explains to the child the whole procedure for solving the problem, working in the zone of child's proximal development. Diverse levels of external help were presented to children step by step, according to operations of cognitive action. After that, the stage of intellectual development in the zone of proximal development was determined by presenting similar (not the same) cognitive actions on the following levels: verbal, perceptive, or materialized actions. The child's potential to fulfill new intellectual actions on one of the levels, was considered an accessible level of working in the zone of proximal development: verbal, perceptive, or the level of materialized actions. If the child was not able to fulfill the new action at any of the mentioned levels, even after working on the stage of orientation, we concluded that such intellectual action was not accessible to the child, at least at this very moment.

Experiment

The task presented by the experiment was for the child to use a logical sequence to find the fourth figure in a series, which has to differ from the third one in the same way that the second figure differs from the first.



Example 1. shows the initial task: square, square with triangle, and circle.

The task was presented on a materialized level with the help of plastic geometrical figures. During the experiment the child was shown the sequence of three given figures, and was asked to complete the sequence by finding the missing fourth figure. The fourth figure had to differ from the third figure exactly as the second differs from the first one. No orientation is presented at the stage of the initial presentation of the task. If the child was able to find the fourth figure, we concluded that this intellectual action was not new for this child. If the child was not able to find the correct figure, the psychologist started to work within an orientation base of action according to the cognitive operations required to fulfill the intellectual task.

The cognitive action used in our experiment includes three consecutive operations:

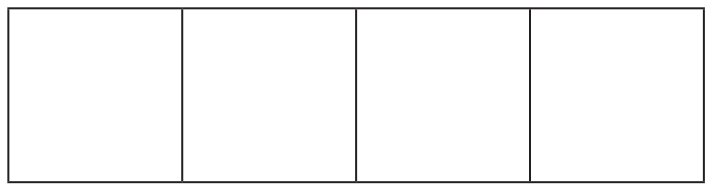
1) The first operation consists of identifying the difference between the first and the second figures.
2) The second operation consists of finding the basic structure of the last figure, similar to that of the first figure.
3) The third operation consists of completing the fourth figure by adding the essential element of the fourth figure (base).

During the experiment, the orientation base of action was also presented on a materialized level.

Orientation

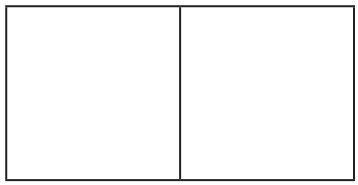
During the stage of orientation, the researcher puts the figures in front of the child above a schema of empty squares. There are no figures in it, but the required places are marked for each figure (*Example 2*). Different geometrical figures (circles, squares, and triangles) are on the table in front of the child in no particular order. The psychologist will put the necessary figures in front of the child in order to provide adequate orientation for the solution of the logic sequence.

The psychologist starts to give the orientation base of action according to the three previously mentioned operations, which represent the three possible levels of help (reduced, incomplete, and complete).



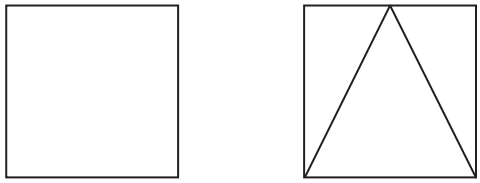
Example 2. Stage of orientation: a schema with spaces marked for the figures

In the case of the reduced orientation, the researcher directs the child's attention and explains that the second figure is different from the first one because it has a triangle inscribed in it. After that, he asks the child to find the fourth figure, which has to differ from the third one, as the second figure differs from the first one. If the child succeeds, it means that he/she needed the first level of help in the orientation base of action. The reduced level of external orientation is enough in that case. *Example 3* shows the reduced orientation.



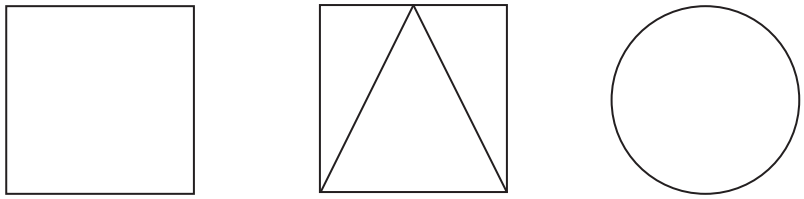
Example 3. Reduced orientation: square, square

If the child makes a mistake, or expresses lack of understanding, the researcher proceeds with the second level of help. He once more shows the child the difference between the first and the second figures. After that, the researcher mentions that the base of two first figures is the same, and this is the similarity between figures. The psychologist stresses the presence of similarity (same base) and the difference (the figure inscribed) between the first and the second figure. *Example 4* shows the level of incomplete orientation.



Example 4. Incomplete orientation. Square, square with triangle

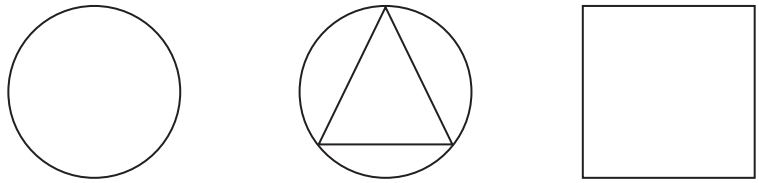
If the child succeeds, it means that he/she needed the second level of help, or incomplete orientation. If the child is unable to find the fourth figure correctly, the researcher continues to work with the orientation, and presents the complete orientation base of action. The researcher starts from the very beginning, explaining and showing all the differences and similarities between the figures, and solving the whole problem in front of the child's eyes. This is the third level of help, or complete orientation. *Example 5* shows complete orientation.



Example 5. Complete orientation: square, square with triangle and circle

So, during the stage of complete orientation, the researcher shows all the steps of the task gradually, if needed, and explains to the child how it should be solved. The stage of the orientation base of action is complete when the child manages to solve the problem independently. There are no limits on the number of times the explanation is repeated during the work with the complete orientation base of action.

After presenting the orientation base of action, the researcher verifies the level of child's potential development, or zone of proximal development. In order to do so, the psychologist offers similar new tasks (never the same task) to the child gradually on verbal, perceptive, or materialized levels. An example of a similar task could be a sequence of a circle, circle with triangle, and a square, where the child is asked to find how the fourth figure differs from the third exactly as the second differs from the first. If the child answers correctly on a verbal level, the experiment concludes, and the level of realizing the answer is verbal. The same thing takes place on the level of images and of materialized actions. *Example 6* shows this task, which could be presented on a perceptive or materialized level, according to the potentialities of each child.



Example 6. Logical sequence: circle, circle with triangle, and square

No orientation is used during verification. The orientation base of action permits us to see whether the child can reach a complex level (verbal presentation and solution) after its presentation at the stage of materialized actions.

The level on which the child fulfills the intellectual action, after the presentation of the orientation base of action on one of its levels of help, points out the potential zone of his/her intellectual development. It means that the child is able to work at this stage after accepting the orientation base of action on the level of materialized actions. The zone of proximal development is determined according to the stage of the child's fulfillment of the new cognitive task, after potentially accepting the orientation base of action presented by an adult during collaboration.

Results

The results obtained in our study indicated that the task presented was new for the majority of children in all socio-cultural groups. Only 15 children (9.37%) were able to solve the initial problem without the orientation base of action. In the rural and suburban groups, the task was not new for only 1 child (2.50%); in the urban group, it was known to 6 children (15.00%), and in the private group to 7 children (17.50%). In the suburban group, there were no children who were able to fulfill the task before the presentation of orientation. *Figure 1* shows these results in the four social groups. The statistical analyses (Anova Oneway) showed a significant difference ($P > 0.001$) between pairs of groups in relation to the potential for solving the

initial cognitive task without orientation. These pairs of groups were: 1) rural and suburban, and 2) urban official and urban private. No differences were found between rural and suburban, nor between urban official and urban private groups.

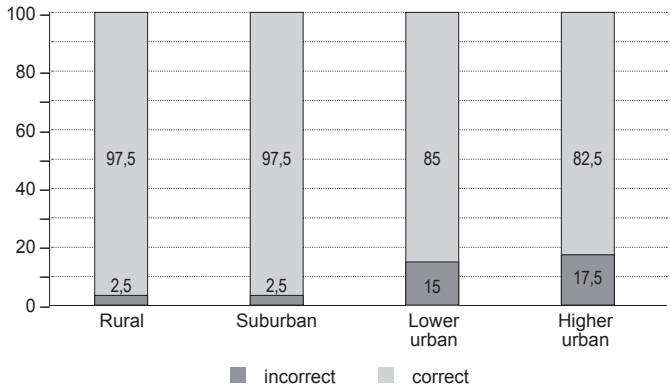


Figure 1. Percentage of subjects with correct and incorrect answers in the first task

Such data allowed us to confirm that the proposed intellectual actions were new for the children, or were not acquired by them in previous contexts. In that case, the adult started the work with an orientation to the children's fulfilling these new intellectual actions. After the work with orientation, new intellectual actions were presented gradually in verbal, perceptual, and material forms.

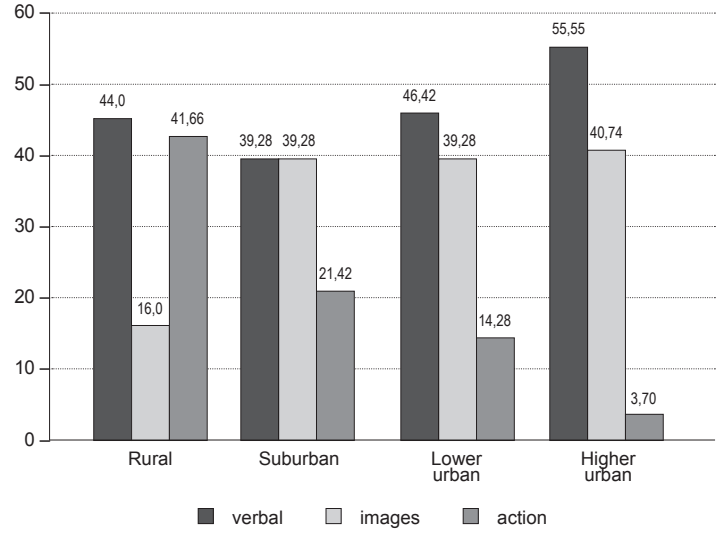


Figure 2. Percentage of subjects with correct answers after orientation base of action at different levels

The results were as follows. After the presentation of the orientation base of action to the rest of children, the majority managed to fulfill the task on one of the levels (verbal, perceptive, or materialized actions). The surprising fact was not only

that the children were able to solve a new task, but that the majority of children from all socio-cultural groups could do it in the stage of verbal thinking. These results are shown in *Figure 2*.

Another interesting finding was that the majority of children needed complete help at the stage of orientation. However, some differences could be noticed between the groups as shown below.

1) *Rural group*. The orientation base of action was presented to 39 children. 64.10% (N=25) of them fulfilled the task after orientation, and 35.89% (N=14) couldn't fulfill the task after presentation of the orientation base of action. 44.00% (N=11) performed on verbal level; 16.00% (N=4) on perceptive level; and 41.66% (N=10) on level of materialized actions.

Levels of help during orientation in the rural group. Only one child required the first level of help (2.56%). He fulfilled the task on a verbal level (9.09% of all children who performed at this level). 17.94% (N=7) needed the second level of help to solve the problem. Of them, 27.27% (N=3) fulfilled the task on the verbal level; 20.00% (N=2) on the level of actions, and 14.28% (N=2) were unable to realize the task at any level. 79.48% (N=31) received complete help. Of them, 63.63% (N=7) performed on the verbal level; 100% (N=4) fulfilled the task on the perceptive level. 80.00% (N=8) completed the task on the level of materialized actions, and 85.71% (N=12) failed.

2) *Suburban group*. The orientation base of action was presented to 39 children. 71.79% (N=28) of them fulfilled the task after orientation, and 28.20% (N=11) couldn't fulfill the task after presentation of the orientation base of action. 39.28% (N=11) of children performed on the verbal level; 39.28% (N=11) on the perceptive level, and 21.42% (N=6) on the level of materialized actions.

Levels of help during orientation in the suburban group. None of the children required merely the first level of help (0.00%). 10.25% (N=5) needed the second level of help. Of them, 9.09% (N=1) fulfilled the task on the verbal level; 18.18% (N=2) on the perceptive level; 16.66 (N=1) on the level of actions. 89.74% (N=35) received complete help. Of them, 90.9% (N=10) performed on the verbal level; 81.81% (N=9) on the perceptive level; 83.33% (N=5) on the level of actions, and 11 children failed to complete the task after orientation.

3) *Urban group*. The orientation base of action was presented to 34 children. 82.35% (N=28) of these children fulfilled the task after orientation, and 17.64% (N=6) couldn't fulfill the task after presentation of the orientation base of action. 46.42% (N=13) performed on the verbal level; 39.28% (N=11) on the perceptive level, and 14.28% (N=4) on the level of materialized actions.

Levels of help during orientation in the urban group. Only one child required only the first level of help (2.94%). He failed to fulfill the task (16.66%). 14.70% (N=5) needed the second level of help. Of them, 9.09% (N=1) fulfilled the task on the verbal level; 18.18% (N=2) on the level of images; 16.66 (N=1) on the level of actions. 82.35% (N=28) received complete help. Of them, 90.9% (N=10) performed on the verbal level; 81.81% (N=9) on the perceptive level; 83.33% (N=5) on the level of materialized actions, and 83.33% (N=5) failed to fulfill the new intellectual task.

4) *Private group*. The orientation base of action was presented to 34 children. 81.81% (N=27) of them fulfilled the task after orientation, and 18.18% (N=6)

couldn't fulfill the task after presentation of the orientation base of action. 55.55% (N=15) performed on the verbal level; 40.74% (N=11) on the perceptive level, and 3.70% (N=1) on the level of materialized actions.

Levels of help during orientation in the private group. Only one child required only the first level of help (3.03%). He fulfilled the task on the verbal level (6.66%). 21.21% (N=7) needed the second level of help. Of them 26.26% (N=4) fulfilled the task on the verbal level, and 27.27% (N=3) on the level of images. 75.75% (N=25) received complete help. Of them 66.66% (N=10) performed on the verbal level; 72.72% (N=8) on the perceptive level; 100% (N=1) on the level of materialized actions, and 100% (N=6) failed to solve the new proposed task after orientation.

Table 1 shows the usage of the various levels of help in different social groups.

Table1. The usage of levels of helping in different groups

	Groups			
Level of Helping	**Rural**	**Suburban**	**Urban**	**Private**
1 (N=3; 2.06)	2.56	–	2.94	3.03
2 (N=23; 15.86)	17.94	10.25	14.70	21.21
3(N=119; 82.06)	79.48	89.79	82.35	75.75

Table 2 shows the performance of children from the different social groups after working with orientation presented by the adult.

Table 2. Percentage of performance in different groups

	Levels		
Group	**Verbal**	**Images**	**Actions**
Rural	44.00	16.00	41.66
Suburban	39.28	39.28	21.42
Urban	46.42	39.28	14.28
Private	55.55	40.74	3.70

Discussion

Our results permit us to stress some important points in relation to intellectual development at preschool age. First of all, the task of cognitive sequence, which required analysis and synthesis of specific elements, was new for the majority of children in all social groups. The children responded positively to the proposition of mutual collaboration with the researcher, and accepted the orientation provided. The majority of children were positively sensitive to the presented external orientation, and the proposition to work together in order "to understand how to solve interesting difficult problems." The children's emotional involvement was total, and they asked for more time and more "problems" rather than returning to their usual work in the classroom with the teacher.

Additionally, there was the unexpected result that the majority of children in all groups performed at a verbal level after the presented orientation. The bulk of experimental research on testing for intellectual development has always expressed the opinion that the verbal level is not accessible to preschool children, especially those in socially deprived conditions of life (DeLacey, 1970; Cole & Scribner, 1977; Lautrey, 1985). In a later publication, Cole stressed that cognitive complex tasks are not accessible to children and adolescents from rural regions of Yucatán in Mexico (Cole, 1997). Similar findings exist about the black population in the United States, who do not succeed in fulfilling complex cognitive tasks on all psychometric tests (Lumsden & Wilson, 1981). It is necessary to realize that in all those types of research, no kind of external orientation or levels of help were ever provided.

We stress once more that the role of the presentation of external orientation adequate to the structure of the task is a significant factor in determining the potential of preschool children. The orientation base of action, created according to the internal structure (psychological content of intellectual action), positively changes the child's perception of the whole problem, and may even lead to further generalization of the new action. The obvious support for such generalization was the fact that the children were able to fulfill the task on the verbal level after the orientation base of action was presented on a materialized level.

At the same time, it is possible to note interesting differences between the social groups. It is obvious that greatest number of children from the rural group found the fulfillment of the initial task impossible. We also found in this group the highest percentage of children who weren't able to fulfill the task after the presentation of the orientation base of action. That doesn't mean, however, that it would be impossible for them to acquire the ability to solve such problems. We can only conclude that at the present moment, and within the conditions of our experiment, the action was not accessible to them even after orientation. We assume that providing expanded external orientation and work at the material level (concrete actions) instead of at the materialized level (geometric abstract figures), would be a suitable method for preparing these children to succeed.

Our experiment found that the children from different groups showed a clear difference in their needs for the stage of materialized actions. A progressive decrement in performance at this stage can be discerned from the rural to the private group. The level of fulfillment of intellectual task was not the only criterion for determining the zone of proximal development. It was shown that children differed one from another not only by their intellectual level for the solution of the problem, but also by the volume (extent) of orientation needed (from reduced to complete). We may say that at the preschool age, the most appropriate level is complete orientation, instead of reduced or incomplete. What we mean by this is that, from a pedagogical point of view, it is convenient to provide complete orientation and assist in the solution of intellectual problems within day-to-day educational practice.

Little children are totally interested in new cognitive problems, and accept new forms of cooperation with an adult. Such ideas confirm the importance of the consideration of the zone of proximal development in the assessment and teaching process as well (Vygotsky, 1984, Talyzina, 2000; Galperin, 2000). In-

stead of this, different modern theories of education and development make a claim to individual constructivism, without any kind of specific orientation and constant use of previous experience (Ferreiro, 1985; Olmos Roa, 2002; Morales & Olmos Roa, 2002). Thus, the whole application of Vygotsky's theory is reduced to constant repetition of the significance of social context and collective collaboration, without stressing the objectives of each psychological age, or features of cultural knowledge which the child has to acquire (Wertsch, 1989; Rogoff, 1993; Feuerstein & Cols., 1980; Hernández, 2014). We believe that understanding the necessity for creating and providing specific orientation for each type of intellectual activity, or introduction to theoretical concepts (Davydov, 1998, 2000; Ilienkov, 2009), remains one of the dominant goals of educational psychology today. Activity theory applied to teaching has proposed useful means for analyzing the operations and content of intellectual actions with concepts, which may help to provide and apply procedures of orientation while assessing and teaching preschool children.

Limitations

The authors are aware that these results do not take into account individual differences which exist among the children in all included social groups for social or biological reasons. The study didn't include the aspects of assessment of "normal" or typical development at pre-school age; that is, it didn't test for the previously acquired abilities or knowledge of the participants. At the same time, we have shown that such individual differences, in normal pupils, are no obstacle to further acquisition of intellectual actions in situations of properly organized orientation. It is obvious that, in the case of work with children with diverse types of learning disabilities or retardations in development, a different kind of orientation might need to be provided. Additionally, specific kinds of conceptual orientation should be studied by psychologists, and provided for particular aspects of the learning process at pre-school and school age.

Conclusions

1. The zone of proximal development might be used as a method for assessing the stage of intellectual development, instead of traditional psychometric and quantitative assessment.
2. The inclusion of the zone of proximal development in the practice of assessment may show not only the potentiality or impossibility of the realization of one or another task, but also essential qualitative characteristics of child's performance.
3. Two main aspects may help determine the zone of proximal development: 1) the stage at which a child acts after orientation, and 2) the amount of this orientation given by researcher.
4. Preschool children, in the majority of cases, need complete external orientation, according to the structure of the intellectual task. Such orientation permits them to solve new intellectual problems on a verbal level after orientation has been presented on a materialized level.

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Understanding of unsafe situations by children with intellectual disabilities

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This article deals with vital questions of the health and safety of children with intellectual disability (mental disability and mixed specific disorders). Theoretical analysis has demonstrated insufficient study of the problem, both in national and foreign psychological and pedagogical studies, although a number of approaches exist. Researchers agree that development of these children is an important condition for the existence of both individual and society at large. At the contemporary stage of development of our society, the safety of the children is all the more relevant since the degree of their development is an important condition of socialization and normal interaction with the environment. Diagnostic tools to estimate the comprehension and recognition of unsafe situations by children with these disorders are still insufficiently developed.

This paper describes the application of a technique called "Recognition of Unsafe Situations", which was designed to study the ability of children with intellectual disability to recognize potentially life-threatening situations (handling household appliances, electricity, medicine, hot or sharp objects, behavior at heights and with stray animals) and to predict the consequences of their actions in such situations. The results of this study allow us to determine the differences in recognizing unsafe situations by children with mental disability and children with mixed specific developmental disorders. We show that children with mixed specific developmental disorders have a certain ability to identify potentially unsafe situations, and with support provided by adults, they are able to predict the consequences of their actions. Children with mental disability, however, have insufficient knowledge of safe behavior; but special activities that take into account these children's ability to compensate enable them to develop the essential skills for behavior in potentially life-threatening situations.

Keywords: children with intellectual disabilities, children with mixed specific developmental disorders, health and safety, understanding of dangerous situations

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Introduction

Today the problem of safe/secure behavior is being considered in various aspects in psychology and pedagogical science research. I.A. Bayeva and her colleagues put forward the concept of safety in the educational environment and psycho-pedagogical support for its participants to overcome various threats, including psychological injuries (Bayeva & Semikin, 2005; Bayeva & Gayazova, 2012; Bayeva & Yakimanskaya, 2013). The authors claim that better understanding of the psychological characteristics of the educational environment requires the study of conditions allowing a person to reveal his inner nature. These conditions are understood as "psychological safety", which provides for "positive personal development of all the participants in an educational process" (Bayeva, 2010, 35). The concept of "safety/security" is understood as "a phenomenon without which neither the personality nor the social organization, society or the economy, and especially the state can undergo normal development" (Bayeva & Semikin, 2005, p. 9). The formation of a healthy sense of security as one of the basic feelings of the person in the view of Bayeva and Yakimanskaya, starts in early childhood in the course of interaction with significant adults (Bayeva & Yakimanskaya, 2013).

Another understanding of the "safety/security" category is offered by T.M. Krasnyanskaya, who takes into account the complexity of the subject and suggests designating the concept as a "system", a relatively stable, self-developing, and self-regulating entity (Krasnyanskaya, 2006a; 2006b). She maintains that one of the major factors in the achievement of security by any system is the complexity of its organization. Elementary systems (for example, primitive organisms) are less adapted to avoid danger, so they perish in a constantly changing environment, whereas "complex, highly organized systems, advanced species, which, owing to certain qualities, possess the developed ability to coordinate their inner and outer functioning in interaction with the world surrounding them, change actively and also influence the environment. It is possible to assume that the complexity of a system is a source that helps build more harmonious relationship with the environment" (Krasnyanskaya, 2006a, p. 239). The author maintains that ability to control endogenous (internal) and exogenous (external) factors guarantees the safety and preservation of an intricate system. If these factors are incorrectly assessed, the subject is exposed to danger, in certain cases even death. On the other hand, Krasnyanskaya notes that "attributing a safety status to any system is quite relative: Speaking about one and the same subject-object interaction, and relying on different reference points, it is possible to refer to a larger or smaller degree of safety of its subject, about a larger or smaller approach to a safety ideal" (Krasnyanskaya, 2006a, p. 240). Thus, the bounds of danger are rather flexible, and the system can regulate its level by means of assimilation, adaptation, or change of the unsafe situation itself. The author also notes that one of the most important psychological reasons for a person finding himself in unsafe situations is "the imperfection of his perception, which doesn't allow him to create an adequate picture of the surrounding world and also to single out signs of danger" (Krasnyanskaya, 2006a, p. 245).

It should be noted that in both above-mentioned approaches, the authors focus their attention on the dangers proceeding from the social environment. In this regard, the task of psychological services lies in the organization of appropriate

psychological assistance to help the individual develop safe behavior appropriate to their age, membership in a particular social group.

We believe that the problem of safe behavior formation should be examined with reference to the restricted awareness of external dangers on the part of children with such developmental disorders as intellectual incapacity. One of the important problems of socialization of children with such developmental disorders is teaching them safe behaviors, i.e., the rules for preservation of life and health, an intention to carry them out, means and methods of health preservation, ways of reacting, and behaving in potentially unsafe situations (Baryaeva, Boykov, & Lipakova, et al., 2001; Shipitsyna, 2005).

The process of a child's socialization implies the mastery of social norms and rules of conduct, including those related to ensuring life and health. L.F. Bayanova points out that any cultural environment is presented through a system of standard situations which, in turn, are a condition for differentiation of rules: "The standard situation is the space of a person's activity and regulates the person's behavior according to the given cultural rule" (Bayanova, 2013, p. 286). To develop the rules of safe behavior of children, it is necessary for them to know which situations are dangerous, to distinguish them from other situations, and to predict adverse effects in case the rules of safe behavior are violated. This is especially relevant to children with intellectual disabilities, whose ability to predict consequences is considerably reduced in comparison with their normally developing fellows.

Today there are some works dealing with the formation of children's safe behavior, including children with intellectual disorders. Scholars and practitioners have worked to develop such behavior in these children (Fantahun, 2009; Mechling, 2008; Ruegg, 2003; Grigoryan, 2008; Davydova, 2009, 2010 etc.). So, according to A.N. Kosymova, the formation of feelings of freedom and safety require teaching children with intellectual disabilities to understand cause-and-effect relations in different vital circumstances. The instability of their intentions and their great suggestibility lead to the development in such children of fixed patterns of behavior, rather incorrect views, which they adopt from their immediate environment without the necessary criticism (Kosymova, 2006).

L.C. Mechling and E. Ruegg write that persons with intellectual disabilities have a specific need to develop their skills for integration into society, since they are unable to distinguish and avoid unsafe situations and don't possess the communicative skills enabling them to report imminent danger (Mechling, 2008; Ruegg, 2003). Analyzing the research dedicated to training both adults and children with intellectual disabilities over a 30-year period (1976-2006), Mechling notes that education (mainly on an individual basis) is necessary for the formation in people with intellectual disabilities of independent behavior which will enable them to move independently outdoors, avoid unsafe situations indoors (fire, poisoning), and injuries (burns, cuts), and provide first aid for themselves (treatment of small cuts, burns, stings of insects), etc.

Research described by A. Fantahun was directed to teach self-help skills to children with intellectual disabilities, including improving their social functioning, interaction with people around them, and safe behavior. It was carried out in Ethiopia at the Kokebe Tsibah educational institution (Fantahun, 2009). The author notes that the purpose of the institution's program is to develop the skills of children of

this category, so that they can be successful in everyday life, live independently in the future, and even develop a professional career. Selection of the individual program for each child was carried out on the basis of his supervision, conversation with parents, and analysis of the children's mastery of the previous programs.

Despite available programs of training in safety skills both in foreign and domestic education of children with intellectual disabilities, formation of these skills is either incorporated into the general educational process, which leads to a lack of attention to safe behavior, or these programs aim at developing skills to overcome only specific problems, such as violence (physical, psychological, or sexual) (Kim, 2010) and safe behavior on the road and at home (Mechling, 2008). Furthermore, researchers who have studied children's skills of recognition, prediction, and reaction to dangerous situations, have used such methods as observation, analysis of documents and products of the children's activity, and also surveys of parents and experts working with these children (Fantahun, 2009). These methods cannot always provide objective information.

Thus, there is a need for further investigation of such children's ability to distinguish situations potentially dangerous to health and life. Such data would allow improvement of methods to teach safe behavior to children with intellectual disabilities. There is also a need to identify distinctions in the abilities of children with intellectual disabilities and mixed specific developmental disorders to single out various situations, including thosethat are dangerous to health and life. This information would allow a differentiated approach to the formation of safe behavior in these groups of children.

Method

Method of diagnosis

Since diagnostic tools to deal with this problem are not currently available, we have developed a technique called "Recognition of Unsafe Situations" (the author is L.F. Fatikhova), which is directed to the study of children's ability to recognize situations that are dangerous to human life and health, and to predict the consequences of these situations. The technique probes the children's ability to orient in such potentially dangerous situations as dealing with household appliances, electricity, medicines, hot or sharp objects, behavior at heights, and stray animals. Stimulus materials are presented by a series of three images for each of the following situations:

1. Picturing potentially unsafe situations;
2. Picturing a situation in which the character is heedless of danger;
3. Picturing the negative consequences of events that have already occurred.

For example, in the series titled "Drugs," the first picture shows a child who has found drugs (Figure 1); the second, a child who has taken a drug (Figure 2); the third, a child who has become sick as a result of unsupervised consumption of drugs (Figure 3). The first picture of each series is presented to the child and the following questions are asked:

1. What is shown in the picture?
2. What could happen?
3. What must be done to prevent it?

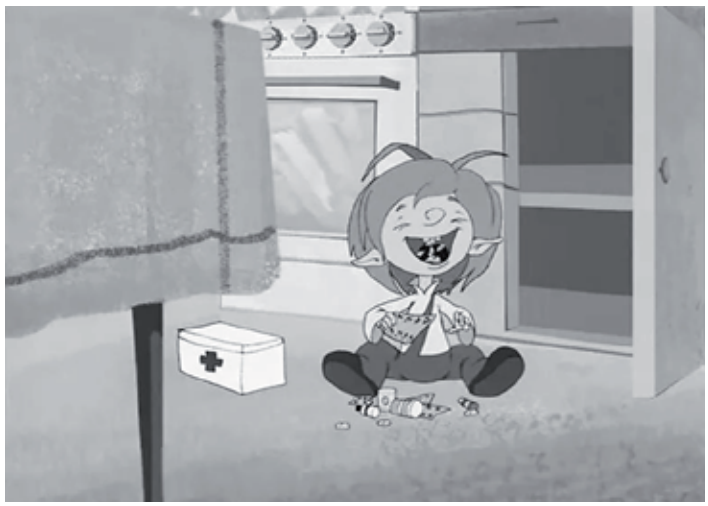

Figure 1. Picture 2 from the "Drugs" series demonstrating a potentially dangerous situation

The instrument is based on the principle of the training experiment and the method of L.S. Vygotsky on the leading role of training in the mental development of the child, taking into account the "zone of proximal development" (Vygotsky, 1935). The idea of using a training experiment and devising different kinds of assistance in working with children with intellectual disabilities was developed by A.Y. Ivanova (2015), B.V. Zeigarnik (1986), V.I. Lubovsky (1989), S.D. Zabramnoy (1995), and S.J. Rubinstein (1999). Thus during a diagnostic training experiment, Ivanova used such forms of assistance as encouragement to take an action, explanation of the nature of the action, presentation of pictures showing how to solve the problem, demonstration of the action for the child to follow.

We provide the following types of assistance if a child is unable to fulfill the diagnostic task of recognizing dangerous situations:

1. If a child can't answer the first question, the experimenter describes the situation him/herself;
2. If a child can't answer the second question, the experimenter provides assistance in three stages:
   a. Showing picture 2, in which the character is heedless of danger, and asking the same question again (see Figure 2);
   b. Showing picture 3, representing negative consequences of events that have already occurred, and asking the same question again(see Figure3);
   c. Answering the question him/herself.
3. If a child cannot answer the third question, he is offered possible answers. For example, in the "Drugs" series, the following answers could be suggested:
   a. One should not use drugs without a doctor's permission and adult supervision;
   b. One should throw the medicines into the rubbish bin;
   c. One should take medicines.

An assessment of the results is carried out for each series separately:

Score of 5 — The child answers all the questions him/herself, understands unsafe situations, is able to identify them and predict their consequences. The child's answers are accurate, based on the specific situation examined;

Score of 4 — The child's answers are inaccurate; he/she detects unsafe situations based only on personal experience but not what is shown in the picture, which is why he/she needs an experimenter's help (assistance type 1), predicts the consequences of unsafe situations, and finds a way to avoid them by him/herself;

Score of 3 — The answers are inaccurate; the child finds it difficult to recognize a dangerous situation, as he/she proceeds only from everyday experience, predicts it when using the second picture of the set (assistance type 2a), finds a way to avoid it;

Score of 2 — The child's answers are inaccurate; he/she finds it difficult to understand the danger of the situation, is able to predict its consequences only when considering the whole situation—the second and third pictures of the set (assistance types 2a and 2b); can't find a way to avoid the danger immediately. The child's reasoning is based only on personal experience;

Score of 1 — The child does not identify an unsafe situation, cannot predict its consequences even when offered help, can name a way to avoid an unsafe situation only when the experimenter offers a list of possible answers (assistance type 3). The child's answers are monosyllabic, unreflective, based on the code of behavior imposed by adults;

Score of 0 — The child does not fulfill the task even if aid is provided, does not detect a dangerous situation, and does not predict its consequences.

The maximum possible grade for all 7 series is 35 points.

Figure 2. Picture 2 from the "Drugs" series in which the character suffers after taking drugs

Figure 3. Picture from the "Medicines" series representing negative consequences of events that have already occurred

The study involved pupils of special (correctional) educational institutions for children with mental retardation and developmental disorders in Ufa, Republic of Bashkortostan, Russian Federation. In Russia, according to 2011 data, there were 1,238 schools for children with mental retardation, and 139,395 students in these schools. There were 131 schools for children with developmental disorders (according to the International Classification of Diseases [ICD], 10 children in this group were classified as children with mixed specific developmental disorders), and 18,740 children were studying in them (*Education in Russia*, 2011).

Participants

Today in Ufa there are three special (correctional) schools for children with mental retardation and one for children with developmental disorders. We examined 77 students of 8-9 years of age:

- 44 students with a diagnosis of "F70 mild mental retardation" (ICD), at special (correctional) school No. 59 for children with mental retardation;
- 33 students with a diagnosis of "F83 mixed specific developmental disorders" (ICD), at special (correctional) school No. 120 for children with developmental disorders.

Children with a diagnosis of "F70 mild mental retardation" are characterized by low cognitive abilities (IQ 50–69) and reduced social functioning. Children with a diagnosis of "F83 mixed specific developmental disorders" have a mixture of specific disorders of speech development, scholastic skills, and motor functions. Common to these disorders is general cognitive impairment, as well as decreased intelligence that does not, however, reach the degree of mental retardation. In Russia, these conditions are described as "developmental disorders".

Results

To determine the quantitative differences in development of the ability to identify unsafe situations by pupils with intellectual disabilities and mixed specific developmental disorders, a statistical analysis using Student's t-test was applied. The results are presented in Table 1. Statistical processing of the results was done with SPSS v.10.0 for Windows, from StatSoft Corporation.

Table 1. Differences in the ability of students with intellectual disabilities and mixed specific developmental disorders to recognize dangerous situations (Student's t-test)

No.	Situations	Mean (children with intellectual disabilities)	Std. Deviation (children with intellectual disabilities)	Mean (children with mixed specific developmental disorders)	Std. Deviation (children with mixed specific developmental disorders)	t– criterion	p– level of significance
1	Household equipment	2.00	1.57	2.51	1.58	1.360	0.178
2	Electricity	2.65	1.82	3.85	1.56	2.987	0.004
3	Medicines	3.12	1.97	4.76	1.03	4.492	0.001
4	Hot items	3.07	1.8	3.94	1.51	2.238	0.028
5	Sharp objects	3.72	1.5	4.39	1.17	2.067	0.042
6	Height	3.09	1.89	4.33	1.17	3.302	0.001
7	Stray animals	2.73	1.86	4.12	1.44	3.508	0.001
8	Integrated indicator of the ability to recognize dangerous situations	20.53	8.53	27.94	5.2	4.406	0.001

According to the data presented in Table 1, there were differences in the recognition by children with intellectual disabilities and with mixed specific developmental disorders of the situations, such as "Electricity" ($p< 0.004$), "Medicines" ($p< 0.001$), "Hot items" ($p< 0.028$), "Height" ($p< 0.001$), "Stray animals" ($p< 0.001$). For "Household equipment," no differences were found between the two groups of children ($p > 0.178$). According to the integrated indicator of the ability to recognize dangerous situations of children of these groups, the differences are statistically significant ($p < 0.001$). Thus, children aged 8-9 with mixed specific developmental disorders were able to recognize situations potentially dangerousfor life and health and to predict the consequences of these situations better than their peers with intellectual disabilities.

Let us now present the specific features of understanding unsafe situations by the children of the groups under study.

Understanding of unsafe situations by children with intellectual disabilities

Our research confirmed that the ability of children with intellectual disabilities to understand a dangerous situation is underdeveloped.

During the discussion of "Household equipment" (which shows a boy trying to get into the refrigerator, whose door can shut and trap the child), children of this group most often started to enumerate objects of the setting, for example: "A refrigerator, a boy, products, a towel, gloves ..." when answering the question, "What is shown in the picture?" Many children simply said, "A boy and a refrigerator". After being shown images with the consequences of the dangerous situation, the children paid attention to the actions of the main character: "He takes something from the fridge". When asked to predict the situation, the children used their personal knowledge, which did not always coincide with the specific situation in the picture. For example, to the question: "What could happen?" they replied: "He could fall", "He could fall down and break a jar", "Food could fall on him", "Mother could scold him for taking it without asking". Since the children gave similar answers, one can come to a conclusion about poor life experience and lack of understanding of the danger. Answering the question, "What should be done to prevent it?" the children could not choose a correct answer by themselves, and answers had to be suggested to them. Many children said, for example, "You cannot open a refrigerator or come up to it without Mom's permission", "I should ask mother's permission to open the fridge", that is, they believe that unsafe situations can be avoided with the help of parents.

The children coped successfully with the "Electricity" series of pictures (careful handling of wall outlets). This area has been discussed at school repeatedly, so most children answered on their own. The children answered the question, "What should be done to prevent it?" in the following way: "Don't meddle with the wall outlets until adults come home", "Do not put objects into a wall outlet", "You have to ask adults to turn on the lights; wall outlets are for adults", "You should not go near the wall outlets" — that is, the children's answers are quite adequate and appropriate to the situation.

Children with mental retardation also coped with the "Drugs" pictures (prohibition of uncontrolled medication) quite well.Some of them needed help in the form of guiding questions, after which the correct answer followed. To the question, "What could happen?" (in the case of the boy in the picture who has taken a lot of medicines), the children mostly answered, "He could die" or "He could choke".

The situations "Hot items" (the need for careful handling of hot irons), "Sharp objects" (the prohibition against playing with them), "Height" (the prohibition of reckless acts on balconies), "Stray animals" (caution) did not cause much difficulty. Children gave the right answers or made the best use of the experimenter's help when there were difficulties. In the "Hot items" situation, answering the question "What could happen?" children often said: "He could burn down the house"; "It could cause a fire, he could burn himself". These answers lead us to conclude that the children already have a stereotype of unsafe situations with hot and flammable objects, but they need help to find other ways out of the situation. In the "Stray ani-

mals" situation, the children gave different answers to the question "What should be done to prevent it?": "Do not touch", "Do not touch the dog", "Do not tease", "Get away from it", "Do not swing your arms, do not come up close to the dog". In general, students with intellectual disabilities were able to orient in this situation, offering appropriate variants of behavior.

The children with intellectual disabilities accepted help and were able to use this aid effectively. The second and third types of assistance proved the most effective. Prediction of the consequences of the situation "Household equipment" caused the greatest difficulties.

Understanding of dangerous situations by children with mixed specific developmental disorders

During the examination it was found that children with mixed specific developmental disorders are underdeveloped in their ability to understand a dangerous situation, as are children with mental disabilities.

In the "Household equipment" situation, pupils of this group often said in answer to the first question, "What is shown in the picture?": "The boy wants to eat," "The boy takes something the refrigerator", or started to enumerate objects in the picture, for example: "A refrigerator, a boy, foods, a towel, gloves...". After being shown images of the consequences of an unsafe situation, some children understood that the main character tries to get inside the refrigerator, thereby exposing himself to the danger of being locked in the refrigerator. When asked to predict what would happen, the children used their personal knowledge, which did not always coincide with the specific situation in the picture. For example: "He could fall", "He could fall down and break the jar", "Food could fall on him", "Mother could scold him for taking it without asking". Most pupils needed help to predict this situation correctly. Some children needed help in the form of possible answers.

The children coped with the "Electricity" situation successfully. To the question "What could happen?" almost all the children said that the main character could get an electric shock. To the question "What should be done to prevent it?" the children replied: "Do not put any object into wall outlets" or "Do not touch wall outlets" — i.e. the children's answers are quite appropriate; they understand how to avoid adverse effects.

The "Drugs" situation was also resolved quite successfully by children with mixed specific developmental disorders. Some needed help in the form of guiding questions, after which the correct answer followed. To the question "What could happen?" (to the character who has taken a lot of medicines), the children often answered, "He could die" or "He could get sick". Generally, the children answered the first two questions correctly and needed help answering the third question.

Recognition of the unsafe situations "Hot items", "Sharp objects", "Height", "Stray animals" and predicting their consequences did not cause any difficulties for the children of this group. Children gave correct answers and did not need assistance. In the situation "Hot items", the children, answering the question, "What could happen?", often said: "He could get burned" or "Fire". In the "Stray animals"

situation, answering the question "What should be done to prevent it?", the children said: "Do not touch stray animals", "Do not touch the dog", "Do not tease them", or "Get away from the dog". In general, children with mixed specific developmental disorders were able to orient in this situation, offering appropriate variants of behavior.

Children with mixed specific developmental disorders received aid in the process of examination. The directing assistance was the most effective.

Discussion

The problem of safety/security is examined in various aspects in psychological science: as psychological safety of the educational environment and safety of a complex system capable of overcoming danger through assimilation, adaptation, or transformation of the dangerous situation. Representatives of both approaches consider it necessary to organize psychological services and to develop a methodology to provide psychological assistance for an individual to cope with dangerous situations, most of which come from the social environment.

Analysis of the research on this problem has also found that children with intellectual disabilities do not show a complete inability to recognize situations potentially dangerous for life and health. Remedial work has aimed at forming in children with intellectual disabilities ideas of safe behavior rules with regard to their compensatory abilities and other psychological characteristics that will ensure their adaptation.

Our results show that children with mixed specific developmental disorders are able to perceive the issue of safety, but not enough. Children cannot always recognize a potentially unsafe situation; they need the experimenter's help to predict its consequences more precisely. Children of this group have difficulties in identifying ways to avoid the danger, which implies a poorly developed social imagination. However, children with mixed specific developmental disorders have some knowledge and understanding of safe behavior. The "Household equipment" situation caused the greatest difficulty. Both children with mixed specific developmental disorders and children with intellectual disabilities had the greatest difficulty in determining the consequences of this unsafe situation.

Conclusion

The empirical study allows several conclusions:

1. Children aged 8-9 with intellectual disabilities are characterized by a reduced ability to recognize situations that are dangerous to life and health and to predict their consequences. Both the current and potential development of this ability in children with intellectual backwardness is lower than in children with mixed specific developmental disorders. This is related to the inability of children with mental retardation to identify the reasons for a situation. This inability is caused by insufficient development of logical thinking and manifests itself in all situations that require the establishment of such relationships, including the recognition of dangerous situations and predicting their consequences. However, these children

can be trained to recognize the most typical situations threatening their life and health, and to prevent dangerous behavior in time. This requires special training with remedial technologies aimed at both correction of cognitive activities and the formation of the necessary life skills.

2. Children with intellectual disabilities and those with mixed specific developmental disorders have differences in the ability to orient in such potentially unsafe situations as those involving electricity, medicines, hot or sharp objects, height, and stray animals, but such differences were not found in the ability to orient in a dangerous situation associated with household equipment. The differences can be explained by the greater abilities of children with mixed specific developmental disorders to predict, compared with children with mental retardation; by the ability of the first group to make observations about their lives and draw their own conclusions from these observations. Children of the second group are less capable of such observations, and conclusions are usually drawn only with the help of an adult and with special training.

The research results can be taken into account when setting targets and developing safety programs for primary school children with intellectual disabilities and mixed specific developmental disorders.

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Proposal for psychomotor development in newborns with low weight according to A.R. Luria's conception

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Low birth weight has a negative impact on psychomotor development, specifically on motor and perceptual functions. In order to prevent this effect, neurodevelopmental diagnosis should be supplemented by an effective therapeutic system. The aim of this work was to test a program for psychomotor development based on A.R. Luria's concept of three functional brain units or blocks and the necessity of stimulation of the first functional unit in early childhood. Stimulation of subcortical systems associated with psychomotor and cognitive regulation may help to set the basis for positive functioning of the cerebral cortex in the coming years. Vestibular exercises and proprioceptive stimulation were used. All exercises included significant communicative activity as described by Vygotsky and Lisina, which provided positive direct emotional contact between adult and child. Twenty-five babies with low birth weight were included in the study, along with their parents. After 250 days in the program, all the underweight children presented positive functional development. We conclude that positive effects of these programs for correction and psychological development may be achieved during the first year of life. The methods for sensitive diagnosis and correction should be considered by all specialists involved in topics of early development.

Keywords: low birth weight, psychomotor development, subcortical systems, joint activity, early childhood

Introduction

Low birth weight may have a negative impact on psychomotor development. It is also considered a determinate negative variable of post-natal growth and a strong morbidity factor (*Bulletin of the World Health Organization,* 1987). Weight between 1,000 and 2,500 grams at birth is classified as low; "extreme low birth weight" is under 1,000 grams (IDC-10, 2010). Hyaline membrane disease, intracranial hem-

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orrhage, and sepsis can develop in newborn children as a consequence of low birth weight. Low or changing muscle tone, absence of straightening and equilibrium reactions, and lack of orientation are frequently detected in these children. Some authors mention that such conditions may lead to or be related to cerebral paralysis (Hack & Caron, 1983).

Other authors have observed problems with motor coordination in children with low birth weight, such as inability to maintain constant muscle tone, delay in acquisition of posture, and lack of consolidation of motor functions (Romero, 1997).

Various studies have described the high incidence of disturbance in perceptual functions; for example, Skranes (2007) showed a relatively high incidence of visual-motor problems with a history of low birth weight. This author also found low fractional anisotropy in the internal and external capsule and the superior fasciculus using tensor diffusion imaging. Such data makes it possible to suggest that low birth weight has negative effects on the central nervous system and that such negative effects could affect cognitive processes in general.

In our country, after being stabilized in incubators, children with low birth weight are sent home. It is not common for children to receive any kind of therapy or neuro-developmental care as a prevention strategy. As a result, the children spend several weeks without the professional attention that is essential for early psychological development. The families are normally not aware of any probable consequences until the monthly pediatric checkup. Medical attention is certainly essential for the child´s future, but intervention in psychological development is also critical for the acquisition of superior or complex organized behavior (Theeboom & Weiss, 1995).

Creation and application of programs for newborn children is an important interdisciplinary task for neuropsychology, pediatrics, and developmental psychology. We are convinced that the best solution is not to try to deal with problems "when the problem arises", but a preventive approach. This idea is based on the conception of the zone of proximal development proposed by Vygotsky (1991).

In this paper, the authors report on an original program for early psychological development based on joint actions involving psychomotor functions and positive emotional contact between adult and child. Psychomotor functions were considered as complex elementary movements according to the conception of Katona (1988). The main difference between Katona's conception and our program is our inclusion of elementary movements in the joint actions of adult and child, oriented toward positive emotional goals according to activity theory, considering object and subject as essential elements of a child's activity.

Method

Participants

Twenty-five newborn children with low birth weight were included in the study. All were assessed by a pediatric and neonatology service. All babies spent an average of 18 days in an intensive care unit to decrease vulnerability to disease.

Instruments

Two instruments were applied for assessment of development during the first year:

1. The Vojta development scale to measure "central coordination disorder" by reflex postures and reactions according to seven positions (Vojta, 2011). Figure 1 shows the seven positions on the scale:

   0 = no disorder in central coordination

   1–2 = mild disorder in central coordination

   3–4 = moderate disorder in central coordination

   5–7 = severe disorder in central coordination.

2. The Hellbrügge psychomotor development estimation scale (Hellbrügge et al., 1980), which includes assessment of basic postures of the child by month.

The study was carried out in the Intensive Care Unit at the General Public Hospital of Cholula of the city of Puebla, Mexico.

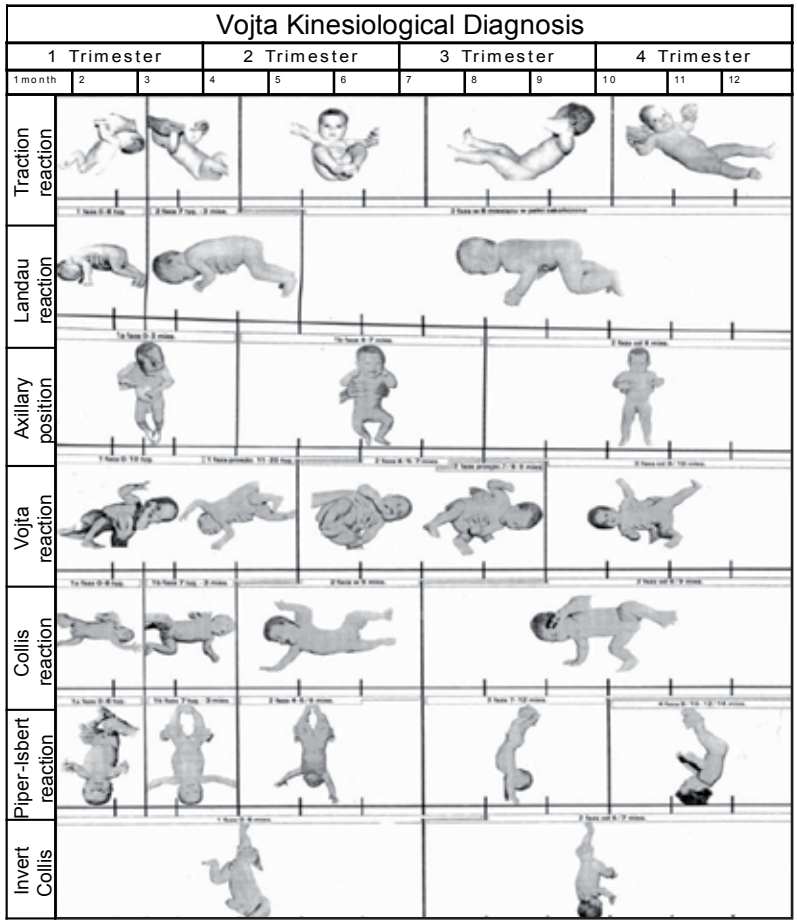

Figure 1. Vojta test of central coordination disorder (CCD)

Sample

All children were systematically attended to by the hospital's neonatology service, which determined the babies' weight.

The treatment was explained to the parents in detail. All parents agreed to take part in the study, to allow administration of the program, and to attend all appointments during the treatment. The average educational level of the parents was nine years. All mothers were housewives, while the fathers were workers at large or small enterprises.

The study was carried out under the ethical and social norms and responsibility issued by the General Hospital of Cholula. The participants were selected according to expert judgment criteria applied by pediatricians and at the temporal convenience of the researchers.

Procedure

1. Children were evaluated in the intensive care unit by neonatology services.
2. Neuro-development evaluation was applied to each child with the help of the Vojta Scale in order to estimate the central coordination disorder.
3. All parents were trained and the content of the program was explained to them. A specialist showed them each exercise, individual competence was achieved, and they were told how to do it three times daily before feeding.

The program was created and approved by the neuropsychology and neurodevelopmental service of the General Hospital in Cholula Puebla. This service is provided and supported by the Master Program on Neuropsychological Diagnosis and Rehabilitation of the Faculty of Psychology of Puebla Autonomous University. During the program, all children were checked every week in order to ensure their progress through the program and to help the parents understand and better perform all the exercises. An expert supervised the performance of the exercises through individual weekly sessions. The program started on the 19th day after the children's birth and initial assessment took place on that day.

The subsequent assessments by the Vojta Scale were on the 150th and 241th postnatal days, to estimate progress in acquisition of elementary motor movements. Additionally, the Hellbrügge Scale was applied to establish functional psychomotor age (Hellbrügge et al, 1980).

Content of the program

The following exercises were included during the first 5 months. All exercises were joint actions between adult and child, trying to attract the child's attention to an object or person. The parents were told to speak with a highly positive emotional tone and expressive attitude towards the child. The adults were instructed to smile, talk clearly, loudly, and precisely to their children. They could sing songs or rhythmic melodies or just speak kindly to the children during the exercises.

The stages of the study are shown in Figure 2.

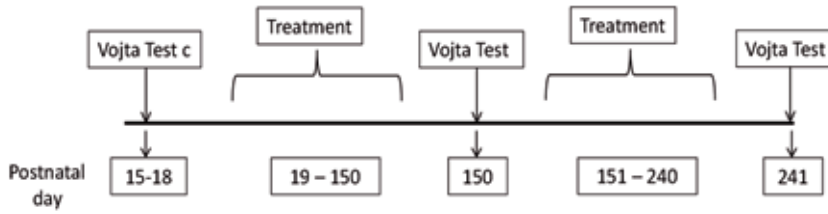

Figure 2. Postnatal age and interventions

The stages of the program are presented below.

Stimulation of tumbling reaction

1. The adult places the baby in a supine (face-up) position, then holds him or her above the elbow with one hand and holds the hip with the other hand. The child gently turns in the opposite direction from which it is being held. The adult shows toys in the direction that the child's head is pointing, points out and names the toy. 20 seconds on each side.
2. The adult raises the baby, holding him slightly above the waist with both hands, then turns the child slowly sideways, up to 45 degrees. The adult orients the child to watch the toys placed nearby. 20 seconds.
3. The adult places the baby in a supine position, then holds him between the shoulder and elbow with one hand, and between the hip and knee of the same side, with the other hand. The adult gently raises the child to cause the elbow of the other side to support him. The adult sings a song while doing the exercise. 15 seconds on each side.

Stimulation of the straightening reaction

1. The adult places a small, attractive toy 15 inches from baby´s eyes and in the midline of the face. The toy is moved slowly from side to side. The adult names the toy and says that it is moving ("*The bird is flying*"). 30 seconds.
2. The adult touches the child's cheeks with thumb and fingers simultaneously on both sides and in a circular motion. It is advisable to look into the child's eyes and name parts of his/her face. 30 seconds.
3. The adult holds the baby by the buttocks while his/her hand rests on the stomach. 45 seconds. The adult may walk with the baby around the room, showing different objects (toys, furniture). It is important for the child to achieve the ability to turn his/her head in the direction shown by the adult.

Facilitation of back-neck-shaft straightening

1. The adult lays the baby face-up and puts an extended hand under the baby's back, while the other hand is placed on the baby's thighs. The adult gently lifts the child, starting from his back. 10-15 seconds. The adult says nice words to the child when he/she rises.

2. The adult raises the baby, supporting him/her under the armpits, in order for the child to hold his body up for approximately 15 seconds. It is recommended that the child look into the mirror, while the adult says that he/she is big and handsome/beautiful.
3. The adult holds the child from the front of the thighs with one hand. The other hand is placed on the child´s abdomen, to lift him/her slowly. 15 seconds. The adult encourages the child: *"You can do it, go ahead, look at me, we'll do it together!"*

Facilitation of movements for crawling

1. In a prone (face-down) position, the baby´s head is lifted by the chin. 15 seconds. The adult may say to the child: *"Look at the mirror! Who's there? Who is so joyful? Look at this teddy bear!"*
2. The adult lays the child face-down, then holds one of the baby's heels and raises the leg. With the other hand, the adult presses the child's other leg up slightly, supporting the first leg. 15 seconds. The adult may play music and sing songs during the exercise.
3. The adult extends the baby's arm gently in a prone position, while the opposite leg is also extended. This exercise is done on both sides of the body for about 15 seconds each. The adult looks into the child's eyes and may say, *"You are so strong and you can do it so well! You are my hero!"*

The second part of the program was applied between the 5th and 8th months of intervention, when the children's age was an average of five months and three weeks. The following more complex exercises were carried out:

Introduction of tumbling reaction as automatic regression to vertical position

1. The adult holds the baby above the elbow in a supine position and rotates the child slowly from one side to another. 15 seconds. The adult may say to the child, *"Look at these nice toys! You will like all of them so much!"*
2. The adult lays the baby on his/her back. With one hand, the adult holds the child by the ankle in order to move his/her leg in the direction of the opposite knee. With the other hand, the adult moves the child's hip slightly in the same direction that the leg is moving. The adult may put on some music and sing. 15 seconds.
3. The adult lays the child face-down and tries to strengthen his/her arms and legs as much as possible. The adult may say, *"I shall make you laugh with this tickling, you will like it so much!"* 15 seconds on each side.

Stimulation of straightening

1. The adult makes sounds with an interesting object (toy), while the baby is lying on his/her back. The adult encourages the child in head rotation. 20 seconds. The adult names an object (toy) and the sound that the object produces *("The bird is singing" or "The dog is barking").*

2. The adult gently massages the baby's neck, arms, hips, and legs on both sides at the same time. The baby is in a supine position. 30 seconds. The adult may say, "*You have such nice little arms, I will touch you gently, you will like it so much*".
3. The adult lays the child on his back and puts one hand between the nape of the neck and the back, trying to raise the baby slightly. The adult may say, "*Listen to how this little bee makes the sound zzzzz when you are up and when you are down you will hear no sound! It is a game!*"

Facilitation of back-neck-shaft straightening

1. One adult carries the baby by the buttocks, while another grasps him/her with both hands and draws him/her away from the first adult's abdomen. 15 seconds. One adult may say, "*You are so big and strong now! You can do everything by yourself! We shall ask your mother/father to look at you!*"
2. The adult places the child in a sitting position on a surface and supports him/her by the back, trying to balance the baby's weight for each side of the body. 15 seconds. The adult may say, "*You are sitting so nicely by yourself! You are so big now! And I shall show something new to you now!*"
3. The adult holds the child at the top of the hip. 15 seconds. The adult should express positive emotions as the child moves in a vertical position, proposing that he or she look in the mirror.

Facilitation of crawling

1. The adult supports the baby's chest under the shoulders in a horizontal position to encourage the baby to move his/her arms and legs. 15 seconds. The adult may say, "*My baby can move so quickly and can have all toys he/she wants! Let's go very far now and get these toys!*"
2. The adult raises one of the baby's ankles as he lies in a prone position. With the other hand, the adult moves the baby´s opposite arm forward. The adult puts on nice music. 30 seconds.
3. The adult performs a circular massage with the tips of the thumbs to the child´s scapula (15 seconds), upper back (15 seconds), and intercostal zone (15 seconds.). The adult may say nice, expressive words and explain all movements. Songs and melodies might be suggested.

Results

The majority of parents became positively involved in the program starting from the second month of exercising. We conjectured that from that point they could observe gradual improvement of the children's movements and positive emotional response. The parents were interested in the program and started talking more to the children, which met with a positive response from the children.

It is important to note that the parents learned not only how to do the therapeutic exercises, but also changed the whole manner of their relationship with their children. Positive emotional contact was accompanied by gradual inclusion of

more complex postures and motor abilities. At each subsequent session, the parents were happy to comment on their children's motor achievements, strength in the arms and legs. They could appreciate stable eye orientation and improved general attention.

Positive changes in psychomotor development were observed from the first to the second assessment and from the second to the third (final) assessment after the completion of the program.

The first Vojta Scale evaluation of complex elementary movements showed an oscillation of values between 1.8 and 4.0, which indicates that the deficit of movement ranged from mild to moderate.

The second assessment was on day 150, after 5 months. Here it was possible to observe changes in the indicators from 1.3 to 3.1.

The third assessment (after completion of the program) was on day 241, after 8 months. The indicators varied from the highest (1.6) to the (0.5). The results of the three assessments are shown in Figure 3.

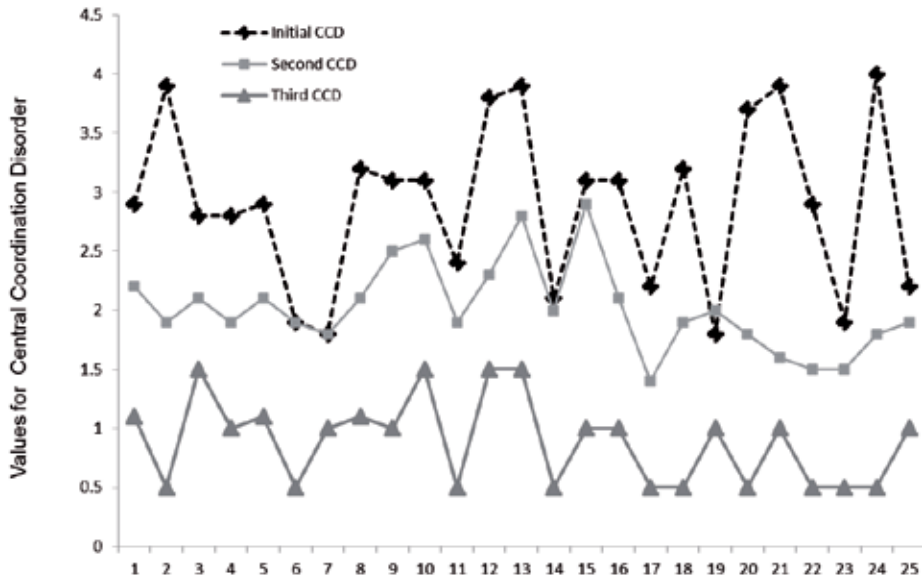

Figure 3. Values for central coordination disorder at three different moments. Each point represents an individual case

Our results show that during the 8 months of working according to the program, the children showed progress in psychomotor development, such as the turning reflex, straightening, pulling, and crawling (Hellbrügge et al., 1980).

Discussion and conclusion

One of the clinical goals of this study was to improve complex elementary movements and to convert them into object-oriented actions. This decreases the risk of developing some sort of incapacity in the future (Katona et al., 1986).

The results show that systematic exposure to therapeutic postures stimulates normal motor organization in specific functional systems. We conjecture that such important changes in motor development could be due to the guided intervention effect of the program.

The exercises of the program constantly included external objects, verbal motivating expressions by an adult, and coordinated movements stimulated by an adult. All exercises were carried out in an expressive and positive atmosphere, creating the possibility for constant involvement of the baby in the joint activity with an adult. This strategy is based on the psychological analysis of early infancy (Lisina, 2009; Leontiev, 2009; Elkonin, 1989), and it helped to create a positive zone of proximal development and to achieve a gradually better response from the babies. An additional psychological effect of the program was the disappearance of negative impulsive reactions such as irritability, weeping, excessively frequent breathing, and chaotic movements of the legs and arms with no apparent goal. All the babies were able to orient the movements of their eyes to external goals or according to the emotional attraction of an adult.

For example, the mother´s image and voice improved the child´s performance during therapy exercises, produced guided sensory orientation effects, and fostered a constant motor orientation. Thus parents should be trained both how to do the exercises and also on how to interact effectively (Pelayo et al., 2013).

We can say that the right development of the motor system makes visual fixation and tracking possible, along with the animation complex (Lisina, 2009; Kamenskaya, 2010). The results of varied treatments for low-birth-weight children point to the importance of the parent swiftly enrolling them in psychomotor developmental stimulation programs (Dawes, 2000).

This psychological disposition of such little children (babies) for immediate environment interaction can be considered as a basis for further formation of more complex functional systems, which combine the proprioceptive, vestibular, and cerebral stem systems (Tisson, 2001). At the same time, it is not possible to assume separate maturation of the psychomotor system without inclusion of high levels of cortical regulation (Machinskaya & Farber, 2014). On the one hand, it is possible that we are speaking about the functions included in the primary functional unit (Luria, 1970); on the other, according to Luria's conception, no action can be performed with the participation of only one functional unit. This logic makes us believe that the program applied in the study permits better consolidation of coordinated efforts between the first and third functional units (Machinskaya & Semenova, 2007). Such coordination can be achieved according to the external objective of the actions proposed by the adult to the child within joint positive emotionally communicative activity (Lisina, 2009).

Our results provide only preliminary evidence, which allows us, however, to reach some conclusions about the neuropsychological theory of development in very young children from a historical and cultural perspective. The results suggest that it is possible to start stimulating development at the very beginning through joint activity between adult and child, which later will be of great importance to create behavioral regulation systems (Solovieva et al., 2009). We can claim that early organization of joint activity between adult and child, always initiated by an adult, permits positive results in communicative activity by itself, as was already demon-

strated by the authors of historic and cultural psychology (Luria, 1977; Elkonin, 1989; Lisina, 2009). Our results point out a clear relation between the development of the nervous system and the level of psychological activity. Positive emotional communication and interaction may require the whole motor sphere, the system of equilibrium, tonic activation, and emotional regulation of activity. The necessity for research into diverse levels of childhood activity has been expressed clearly by the theory of cultural activity (Taliizna, Solovieva & Quintanar, 2010; Leontiev, 2009).

The program for stimulation of early psychological development, fulfilled as oriented joint activity and not as isolated movements, may be understood as an essential part of the communicative activity necessary for children with neurological risks because of unfavorable birth conditions. Thus, emotional communication with the parent is essential to the emergence of developmental milestones and with them the effects on modulation systems between the first and third functional unit.

Finally, we may say that higher regulatory centers may be involved in cultural actions on this basis, and simultaneously with their direct interactions with subcortical systems of the brainstem and midbrain (Luria, 1973; Machinskaya & Farber, 2014).

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A new perspective on autism: Rita Leal School

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Guided by the principle that scientific knowledge should serve to transform reality and create suitable conditions of life for all, the Portuguese Association for Relational-Historical Psychology (APPRH) founded a school named RITA LEAL (RLS), with a therapeutic purpose based on new perspectives for treating autism — perspectives quite different from instrumental and behavioral learning programs. The Rita Leal School (Leal, 1975/2004, 1997, 2005, 2010) is rooted in the theory that mental development is based on a mutually contingent emotional relationship, while it underwrites Vygotsky's concept of the Zone of Proximal Development (ZPD) and Mediation (1930/2004, 1934/2009). Learning to read is a complex process which individuals with Autism Spectrum Disorder (ASD) master slowly and with difficulty. We analyzed the process of learning to read of two ASD children accompanied by peers without special educational needs, aiming to pinpoint distinct aspects of their progress. We used the Observer Software Program to collect and analyze observations of their performance, which were understood as data to be classified according to previously specified codes. We believed we could demonstrate that, especially in the case of ASD children, learning is dependent on contingent responses and adequate levels of mediation. The technical team at the RLS has continuous clinical supervision. That is because we believe this supervision is what permits the team to undergo a process of de-centering, becoming more empathic and accessible to the autists. This makes the team's intervention more efficient, because it becomes more aware of each autist's individual characteristics, and therefore more available to respond to the autist's needs.

Keywords: autism, contingent emotional development, mediation, zone of proximal development

Introduction

The term "Autism" was first introduced by Paul Eugen Bleuler (1911), who described it as a symptom of schizophrenia, understood as a "shutdown of reality and (...) predominance of inner life" (Bleuler, 1911/2005, p. 109).

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In 1943 Leo Kanner published the first description of child autism: "*Autistic Disturbances of Affective Contact.*" He considered autism a rare neurological condition distinct from schizophrenia: "the inability to relate to others beginning in the first years of life" (p. 242). Most of the children he observed developed language, but did not employ it for communication with others (Kanner, 1943). He described them as deeply sick and isolated from society, and as the product of a toxic environment provided by their caretakers. Kanner's hypothesis, which assigns blame to parents for autism, became common in the 1940s and 1970s.

Contemporaneously, Hans Asperger published an article entitled "*Autistic Psychopathy in Childhood*" (1944). Having observed a more diversified group, he described cases which were very similar to those presented by Kanner, and stated that autism should be conceptualized as a s*pectrum*, ranging from "highly original genius to the mentally retarded" (Asperger, 1944/1991, p. 74). His intention was not only the habilitation of autists, but better identification of their capabilities and recognition of their potentialities.

While some of the children Kanner described did not use language, and others showed disturbances in communication, those observed by Asperger "talked like adults" (p. 39), although they showed a deficiency in social interaction and communication (Asperger, 1944/1991).

In 1980, the American Academy of Psychiatry (APA) again advanced the classic concept initially described by Kanner, and classified autism as a Comprehensive Development Disorder (3rd ed.; DSM-3; APA, 1980). But, in 1984, the ninth edition of the *International Classification of Diseases* (ICD-9) described autism as a form of psychosis, beginning in childhood and tending to develop into schizophrenia (Artigas-Pallarès & Paula, 2012). After this period, the two most used systems of diagnostic classification considered autism a category distinct from other psychiatric pathologies.

A 2013 reformulation by the *Diagnostic and Statistical Manual of Mental Disorders* (DSM) brought significant changes in the diagnosis of autism. All subcategories were replaced by the more comprehensive diagnosis of Autism Spectrum Disorder (ASD). The main criteria are: "persistent deficits in social communication and social interaction in multiple contexts"; "restricted and repetitive patterns of behavior, interests and activities"; and "the symptoms must be present in the early stages of development" (5th ed.; DSM-5; APA, 2013).

Several levels of severity were defined which describe the criteria for treatment: needing help; needing substantial help; and needing very substantial help (5th ed.; DSM; APA, 2013). Progress seems to stem mostly from the enhanced number of levels of help envisaged, which define a wide range of diagnostic differentiation (though rather simplistic and unclear), and point to some sort of external (social) aid as a valid instrument for future research.

Nonetheless, we believe that the scientific community still lacks a strong and distinctive theoretical reference point leading to a clear definition of a clinical treatment method for ASD. Looking carefully at the latest diagnostic criteria presented, which focus on isolated symptomatic behavior and the discrimination of the levels of severity of disturbance, this new definition maintains the underlying thesis of a biological cause, and the conviction that the social environment can merely mitigate the intensity of various autistic behaviors. Thus the temptation persists to view

autism as split into distinct parts, and not as a disorder which has a relational origin, and a systemic and unique format. This confusion has existed from the beginning, as shown in the ideological duality found in the therapeutic community — biological vs. social, materialist vs. idealist — and in different treatment projects introduced over time. Thus, multiple therapeutic treatment methods for autism were applied: psychoanalytical, conditioning, psychopharmacological, shock treatment, family psychotherapy, and their multiple combinations. In most cases, not much symptomatic change occurred.

Rita Leal School

The Rita Leal School (RLS) project posits the evolutionary or transformational character of pathological phenomena and considers the ASD individual an active element in the treatment process. The RLS accepts DSM-5 and ICD-10 criteria as guidelines for observation, evaluation, and training; nonetheless, it does not deem them sufficient for understanding the real possibilities for clinical treatment.

The RLS maintains that mental development is based on a mutually contingent emotional relationship (Leal, 1997/2004, 1993, 2005), while underwriting Vygotsky's concepts of Zone of Proximal Development (ZPD) and Mediation (1930/2004, 1934/2009), and Quintino-Aires' (2001) understanding of relational-historical clinical intervention procedures with autists.

Relational-Historical Theory posits the relational origin of higher nervous function structures. In line with this theory, Quintino-Aires called the process of construction of the human mind "psycho-poiesis" (2016, p. 302), indicating that this process proceeds through action in the context of an interpersonal relationship mediated by the culture in which the individual is immersed, and which is equally the culture of his responders (p. 302). Vygotsky (1934/2009) first described this process, naming it the General Law of Double Development.

Nonetheless, there remained a gap in understanding the mechanism through which the brain of the new-born human baby first comes to establish the relational link which transforms the brain into an instrument of consciousness.

Proceeding from John S. Watson's research on young babies' "Contingency Analysis" of responses to its own acts (1967), Leal (1975/2004) studied this fixed action pattern. She called it an innate pattern of searching for a contingent response to one's own action — a biological mechanism present from the child's first days of life, to be understood as a turning point for the development of the human psyche (1975/2004, 1993, 2005, 2010).

Her lengthy studies resulted in a theory of "Genetic Affectology" (Leal, 1997, 2005, 2010), a description of the sequential socialization processes driving the construction of the human mind, and opening up an understanding of a distinct socio-historical form of relational exchange between humans. In short, innate biological mechanisms are mediated by a responding Other, and converted into social functions, allowing the birth of language structures and the appearance of regulatory functions of human behavior (Vygotsky & Luria, 1996). If this biological mechanism is disrupted, the invitation for a spontaneous attachment to the human infant is disturbed, as well as his natural affiliation to the species, and thus the development of conscious behavior.

In observing sequences of imitative behaviors, both Watson (1967) and Leal (1975/2004) noted that the initiator is the infant, not any external element; this results in a so-called "proto-conversation," experienced by babies as pleasurable play, which confirms the baby's agency (Leal, 2010, Quintino-Aires, 2016).

The next step is the exclusive responsibility of an Other for producing social behavior in the infant. It is the caretaker's job to establish cognitive and emotional exchange based on biological mechanisms, thus allowing consciousness to emerge. A disruption of this relational format may be seen as causing those autistic disturbances described by the DSM and ICD.

Leal (1975/2004, 1982) and Quintino-Aires (2016) defend the possibility of later intervention in the process through adequate implementation of a model of exchange relationships, which involves mutually contingent responses that foster the development of personality and the structuring of higher nervous functions.

The clinical intervention model applied by the RLS rests on these premises, and introduces a therapeutic model based on the scientific research of Leal, Quintino-Aires, Vygotsky, Luria, and Leontiev.

Intervention

Intervention is based on training health and educational professionals and peers (children and adolescents with strong empathic capacities) to re-establish a mutually contingent format of interchange with ASD individuals (Leal, 1975/2004, 1993, 2005, 2010).

Intervention focuses three principal and interrelated dynamic axes:

- Axis 1: ASD individuals. Before integration into the RLS, each ASD individual is followed through two weekly sessions of psychotherapy and neuropsychological habilitation, with the purpose of getting to know their individual characteristics. The clinical team applies systemic psychotherapeutic techniques centered on motivation and mutual attention, which are understood to be necessary for seizing words as signifiers, a fundamental process for organizing ASD individuals' behavior, and forming human relationships (Quintino-Aires, 2016);
- Axis 2: Parents. The heart of the method rests on scientific evidence that interaction between parents and their children with ASD plays an ever more important role in wide-spread habilitation (Bowen, 1993; Green et al., 2015). Consequently, they have an active role in the treatment process, the goal being to enable them to recognize and interpret their children's attempts to communicate;
- Axis 3: Peers. The RLS program actively encourages the integration of individuals with ASD into heterogeneous groups of peers, and involves them in learning situations, thus putting into practice UNESCO's basic principles of human rights (UNESCO, 1994; ONU, 2006).

The RLS program takes place weekly in the presence of a supervisor, two primary school teachers, two psychologists, one social worker, nine peers and three ASD individuals. Every session is filmed, so as to be able to be used as material for analysis. Also, at the end of each session, the team members record themselves discussing their experience in that session.

A second supervisor is responsible for the group's clinical review of the videos. The continuous supervision is intended to optimize the attentive quality of professionals and peers, and encourages mediation processes between participants.

Clinical supervision and training

Audio-visual support is the main methodological feature of clinical supervision, and allows videotaped interventions to be subsequently discussed by supervisors and the technical team. This analysis allows discussion of the mediational activity of each professional (Clot, 2006, 2010).

All work begins with intensive training in the general techniques for establishing relationships with ASD individuals, and handing over the initiative for contingent exchange to them, since the aim should be to improve the professional's relational availability. Therefore, this relational attitude only becomes effective when:

- Mutually Contingent Exchange establishes a relational pattern (Leal, 1975/2004, 2003, 2010);
- Empathic understanding exists, consisting in the professional taking in the autist's *Eigenwelt* (inner world), absorbing his or her subjective representations (Quintino-Aires, 2016);
- Naming and the Narrative emerge, leading to a constant description of events and training the "scenario" of accepting the roles that arise (Leal, 1975/2004, 2015; Quintino-Aires, 2016).

In addition to these general attitudes, professionals must never forget specific historical-cultural techniques. These techniques, when used to respond to the communication needs of the ASD individual, increase the possibility of appropriating their culture:

- Repetition increases verbal production with communicational value (Leal, 2003, 2015; Quintino-Aires, 2016);
- Emotional echo, consisting in naming the emotions/feelings transmitted or described by the subject without being conscious of them, thus helping the child apprehend feelings in respect to things, people, and/or events (Leal, 2003, 2015; Quintino-Aires, 2016);
- Generalization is used to reduce the child's anxiety by conveying that a certain experience is typical of the human condition (Leal, 2003; Quintino-Aires, 2016).

Pedro Ferreira Alves, mentor and supervisor of the RLS, has been developing a list of orientations for supplementing these techniques, centered on attaining quality in the dialogic relationship between the professionals and the autistic child:

- Training attention and focus: obtained through promotion of eye contact and the habit of saying the autistics' child name in the course of interactions; this creates involvement with the activities/reality;
- Transmitting a sense of security: a comforting touch or presence has a synchronic character, both physical and emotional (Winnicott, 1951, 1965; Leal, 2005);

- Relational support: this promotes mutual attention and the ability of the individual to be an integral part of the group;
- Verbal/emotional expression: signaling verbally to, and resonating emotionally with, the autist's concrete reality, thus translating this reality for them.
- Everyday situations: promoting psychological development, stressing a sense of security and resourcefulness to get acquainted with day-to-day problems. (Gudeman & Craine, 1976; Trexler, 2012);
- Concrete descriptions or questions: it is necessary to describe or to ask questions in an accessible way to the ASD individual, since abstract, vague ones, or those containing simultaneous instructions, are not assimilable. The relational process mediated by the techniques listed above allows the construction of a plan of intervention in accordance with the subject's ZPD.

Method

Goals of research

We try to understand the relationship between intervention techniques, the relational involvement of each professional and peer, and the development of social skills and motivation for learning by ASD individuals. So, in analyzing two of the ASD individuals of RLS (both ten year olds), the specific goals are:

1) demonstrating that supervision has the effect of de-centering the professionals, meaning that the team is more aware of each autists' individual characteristics, and therefore more available for the autists' needs;
2) demonstrating that the evolution of the relational quality contributes to promoting cooperative learning.

Research procedure

The research counted on audiovisual resources to register the field work. "*The Observer XT 12*" software (Noldus, 2014) was used to analyze observational records, classifying them according to previously specified codes that permit the construction of nuclei of signification (Aguiar, Soares & Machado, 2015).

Two groups of data were analyzed:

1. The professional's team verbal and non-verbal discourse recorded at the end of each session;
2. The observed relational dynamics, which demonstrate the interaction and motivational quality of the intercourse between the professionals, peers, and ASD individuals in the recorded learning situation.

Analysis of verbal and non-verbal discourse of the professional team. 108 individual interviews were analyzed. Each team member was asked to *describe* his/her daily experience in the project. The verbalization of the experiences produced three principal nuclei of signification. A total of 38 discriminators were defined, organized in the categories described in Table 1.

Table 1. Analysis of Verbal and Non-verbal Discourse Discriminators

Category	N
Self-appraisal	10
Hetero-evaluation	11
Description of ASD individuals:	17
dialogic relationship	12
cooperative learning	5

The first nucleus identifies different reactions when one is pondering one's own action. The second indicates the view of the group's actions by the participants. The third nucleus focuses on descriptions of each autist, divided into two categories: the dialogic relationship and cooperative learning. To see a full description of each discriminator, refer to Appendix A.

The length of discourse and frequencies of each discriminator were identified.

Analysis of the relational and motivational quality of a learning situation. This analysis was made from choosing video recordings which contained instances of cooperation in a basic academic concepts learning situation, specifically reading, in which at least two ASD individuals were present. After analyzing these recordings, a moment of cooperative success in reading was identified, as this was the concrete goal of the RLS. The 52 discriminators which were defined were divided into 5 categories, as shown in Table 2.

Table 2. Behavioral Analysis Discriminators

Category	N
Motor reflexes	15
Verbal reflexes	8
Relational behavior	10
Techniques	13
Emotions/feelings	6

Motor reflexes focus on all the motor actions taken by ASD individuals, peers and professionals. Verbal responses indicate behaviors with communicational content. Relational behaviors describe behaviors intended to establish relationships. So-called techniques include all actions by psychologists, teachers, and competent peers with the explicit aim of incentivizing the formation of relationships and learning. The category emotions/feelings points out the emotional resonance observed in the ASD individuals. To see a full description of each discriminator, refer to Appendix B.

Frequencies of distinct behaviors were identified, thus bringing out instances of success in the observed sequences.

Results

Verbal and non-verbal discourse of the professional team

Global considerations. In *Figure 1*, one may see the total length of discourse of each nucleus of signification. The blue line indicates self-appraisal, while the red line registers hetero-evaluation, these being more salient than other categories. It should be noted that on days 10, 11, 16 and 17 there was no supervision of the RLS activities. In the supervisors' absence, professionals and peers became more centered on private preoccupations, feeling the difficulties of the project more intensely, while expressing the need for supervision.

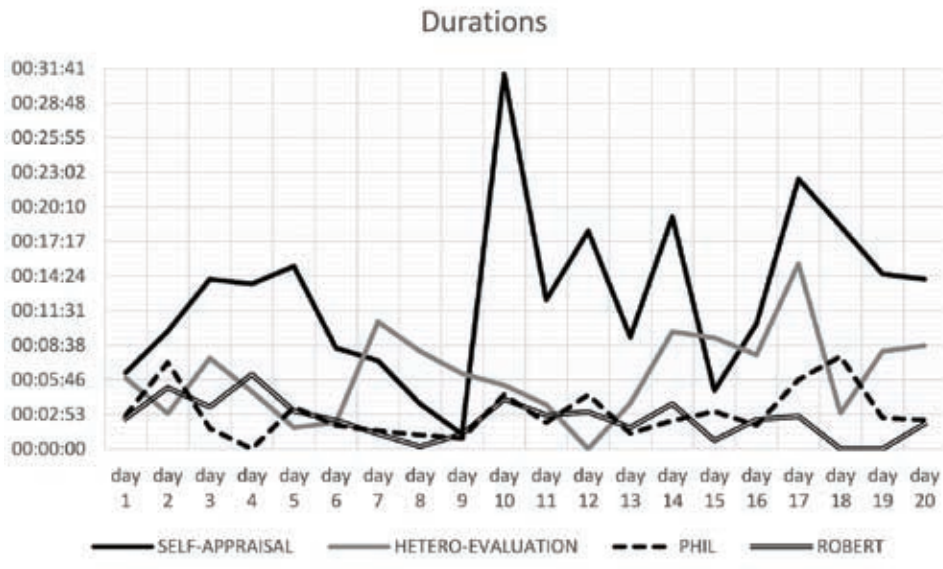

Figure 1. Length of discourse of each category of verbal and non-verbal analysis

Self-appraisal. In Table 3, one may distinguish "Liked" as the most frequent discriminator (*f*=307), followed by "Insecurity" (*f*=205), indicating that the team is constructing a differentiated picture of the difficulties in establishing a relationship with someone with ASD — i.e., constructing realistic involvement. Note that on the days when supervisors were absent, "Insecurity" rose drastically, and then decreased with their return. This process is underscored when you consider other discriminators such as "Tiredness," "Need for Supervision," and "Negative Expectations." This shows the importance of continuous supervision, which, by making the creation of the relationship more conscious, improves the intervention.

As for "Achievement," the highest value occurs on the first day that supervisors were absent, but decreases abruptly on the next day, as if the team was wanting to prove its competence, only to encounter difficulties in maintaining a contingent relationship with the autists. That is probably why "Activity Structured in Supervision" was more common on the first day of the supervisor's absence, as if there were an augmented need to have the guidelines of previous supervision.

As the team gains self-consciousness, each participant may construct a more encompassing understanding of the other, thus attaining greater efficiency in the habilitation of the ASD individual. The aim is to obtain an ever more empathic, i. e., de-centered, team.

For the extended table, refer to Appendix C.

Table 3. Discriminator frequencies of the self-appraisal category (abbreviated table)

Day	…	9	10	11	12	…	15	16	17	18	…	*f*
Liked (+)		4	16	9	15		7	11	9	12		**307**
Insecurity		**4**	**35**	13	6		3	11	7	**1**		205
Achievement (+)		0	**20**	**9**	2		0	5	4	1		110
Tiredness		3	**9**	**9**	5		2	4	3	1		89
Supervision need	(…)	2	**11**	6	**3**	(…)	3	4	4	**0**	(…)	79
Achievement (–)		0	**9**	0	1		0	5	3	2		55
Expectation (–)		1	**7**	1	1		0	0	0	0		31
SUPERVISION activity structured		0	**4**	1	1		1	1	1	0		22

Hetero-evaluation. Looking at Table 4, we see that the themes of positive "Success" (*f*=248), and positive "Confidence" (*f*=96) stand out, followed by negative "Organization" (*f*=95). Again, the need for organization and supervision is underlined in the discourse, revealing the team's preoccupation with the functioning of the group. Note the increase in negative indicators found in discourse on the occasion of the supervisors' absences. Negative values for "Organization" increase strikingly, and decrease to zero with the return of supervisors. The same is observed when considering negative "Confidence" and "Expectation." This negative evaluation shows the group's high level of commitment to finding access to the world of each ASD individual. The days in which "Activity Structured in Supervision" was more prominent were those when supervisors were absent. This suggests that interpolating supervision with its occasional absence causes an increase in the team's effort to become aware of the objectives elaborated during supervision.

For the extended table, refer to Appendix D.

Table 4. Discriminator frequencies of the hetero-evaluation category (abbreviated table)

Day	…	9	10	11	12	…	15	16	17	18	…	*f*
Success (+)		6	17	4	15		2	8	7	10		**248**
Confidence (+)		4	10	3	2		3	1	1	4		96
Organization (–)		**0**	**16**	5	3		1	8	**29**	**0**		95
Supervision need		**0**	**8**	5	5		1	6	**12**	**1**		71
Supervision activity structured	(…)	2	6	2	2	(…)	3	**7**	**12**	7	(…)	64
Success (–)		0	4	1	0		0	2	4	0		28
Confidence (–)		**0**	**4**	1	2		1	1	**10**	**0**		23
Expectation (–)		**0**	**4**	1	1		0	0	0	0		15

Description of each ASD individual

Robert

Dialogic Relationship. It is clear that Robert's stance is very emotional (as presented in Table 5), and shows his urgent need for a dialogic relationship, a need which is revealed by his key actions (Elkhonin, 1998) being identified as "Play" (*f*=34) and "Initiative" (*f*=17). "Peer interaction" appears more often than "Interaction with professionals," but "Cooperation" and "Displeasure" are expressed verbally, which is a good indicator of mental health. The frequency of references to "Play," "Initiative," and "Cooperation" attests to therapeutic effectiveness.

Table 5. Discriminator frequencies of the children's description category — Robert, dialogic relationship

Dialogic relationship		**F**
Playing	Positive	34
Displeasure	Verbal	27
Initiative with speech	Positive	17
Interaction	positive, peers	16
Cooperation	Positive	15
Interaction	positive, professionals	13
Verbal communication	positive, daily concepts	12
Interaction	negative, peers	11
Interaction	negative, professionals	11
Joy		8
Pleasure	Positive	7
Touch	Positive	5
Initiative with speech	Negative	4
Playtime	Negative	3
Touch	Negative	2

Table 6. Discriminator's frequencies of the children's description category – Robert, cooperative learning

Cooperative learning		*f*
Learn	positive, basic academic concepts	35
Task support	positive, professionals	15
Rules	negative	14
Rules	positive	10
Attention	positive	10
Task support	negative, professionals	6
Task support	positive, peers	6
Attention	negative	4
Learn	negative, basic academic concepts	3
Learn	positive, daily concepts	3
Teach	positive, basic academic concepts	3
Task support	negative, peers	1
Teach	positive, daily concepts	1

Cooperative Learning. As can be observed in Table 6, Robert is very open to learning basic academic concepts. He is the child whose indicators show greater consistency; thus he demonstrates a huge potential for learning, and ease in asking for help when he's experiencing difficulty.

The fact that "Playtime" was identified as a main activity at an early stage simplified the implementation of a dialogic matrix for the learning process. It is important to highlight that after joining the RLS, Robert started getting positive grades in Mathematics.

Phil

Dialogic Relationship. In Table 7 one may identify the key activities (Elkhonin, 1998) which Phil developed; **"**Interaction with Peers,**"** "Play," and "Initiative" in the relationship stand out. Note that Phil, being the most severe case, managed to present moments of "Initiative," "Cooperation," and "Touch." Regarding Phil's availability for "Interaction with Peers," he showed a remarkable evolution. His greater availability to relate to peers was very apparent. This underlines the importance of having heterogeneous groups in social and school situations which include ASD individuals, as this is a determinant factor in the development of the autist's social capabilities.

Table 7. Discriminator frequencies of the children's description category – Phil, dialogic relationship

Dialogic relationship		***F***
Interaction	positive, peers	25
Playing	Positive	24
No energy		22
Pleasure		17
Interaction	positive, professionals	14
Initiative	positive	13
Cooperation	positive	13
Comunicate verbally	negative, daily concepts	12
Touch	Positive	11
Joy		11
Displeasure		9
Verbal communication	positive, daily concepts	2
Interaction	negative, professionals	2
Visual contact	Negative	2
Initiative	Negative	1
Interaction	negative, peers	1

Cooperative learning. In Table 8 the team concretely identifies Phil's ZPD. Phil is open to acquisition of basic academic concepts, even if he needs the help of peers and professionals to hold his attentive actions in place, and organize his perceptions.

Early on, it was noted in practice that the autist's availability to be involved in learning situations was increased when mediation included competent peers as protagonists.

Table 8. Discriminator's frequencies of the children's description category – Phil, cooperative learning

Cooperative learning		*f*
Learn	positive, basic academic concepts	31
Attention	negative	22
Task support	positive with professionals	20
Attention	positive	10
Task support	positive with peers	9
Rules	positive	9
Task support	negative with professionals	8
Rules	negative	7
Learn	negative, basic academic concepts	5
Learn	positive, daily concepts	4
Learn	negative, daily concepts	2

Analysis of the relational and motivational quality of a learning situation

Instances of learning situations. As child development proceeds through external mediators such as toys, drawing, and constructions — as introduced in play therapy — tasks of neuropsychological development are launched, and respond to the child's growing curiosity. These tasks open space for the child to structure rudiments of grammar and math, familiarize himself with the nature and phenomena of social life, train coordinated movements, and learn other skills. In all cases, the initiative comes from the child; then regulating guidelines are introduced.

In the first week of the RLS an interesting development produced the following scenario. Robert, a child with ASD, took the initiative of starting to read, and showed enormous pleasure in this. In supervision it was suggested that the book could be constituted as an external mediator to promote the group's interest in reading. In the second week, Robert took the initiative of starting to read, and the professionals encouraged peers to involve Phil in the activity. The results of the analysis will be presented below.

Training the dialogic relationship. The graph shows Phil's visual contacts during motivational moments in the course of one day at the RLS. One may observe that he clearly prefers making visual contact with Robert, his peer. He also displays contingent behavior in respect to other peers and therapists, though in lesser quantity.

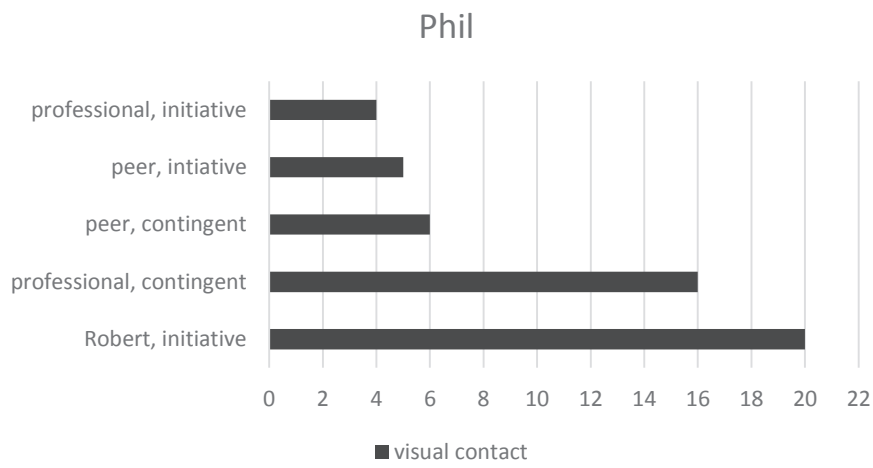

Figure 2. Phil's visual contacts

Motivation for reading. It is clear that Phil prefers being near his peers. His initiatives and intentions are generally directed to Robert or other peers, preferably in the same age group. In respect to therapists, he may be contingent, but does not show initiative.

To make it possible for Phil to develop closeness and common interests when approaching his peers, it was necessary for the group to experience Robert's curiosity for reading during the first week, and to wait for him to be motivated to share his interest with Phil. This moment of cooperation during reading emerged at Robert's initiative, enabling Phil to develop this interest in reading, as is shown in the following graph (Figure 4).

You may observe that visual contact occurs most often when Robert takes the initiative in relation to Phil. He both says his name and points with his finger when prompting Phil in reading, or correcting him. This relational dynamic culminates in the moments of contingent cooperation between both.

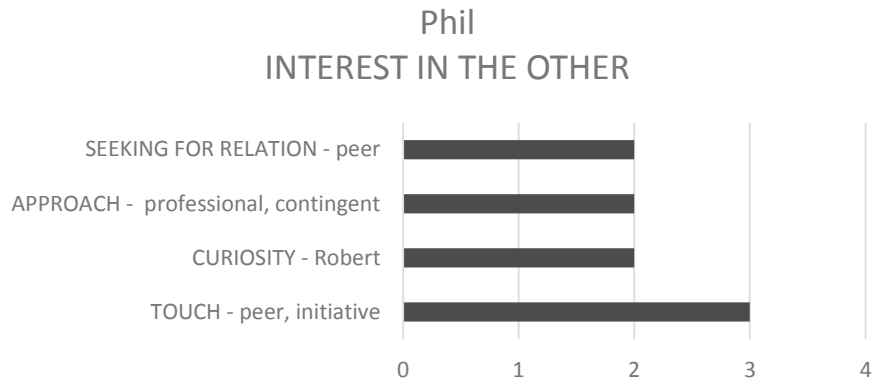

Figure 3. Phil's interest in the other

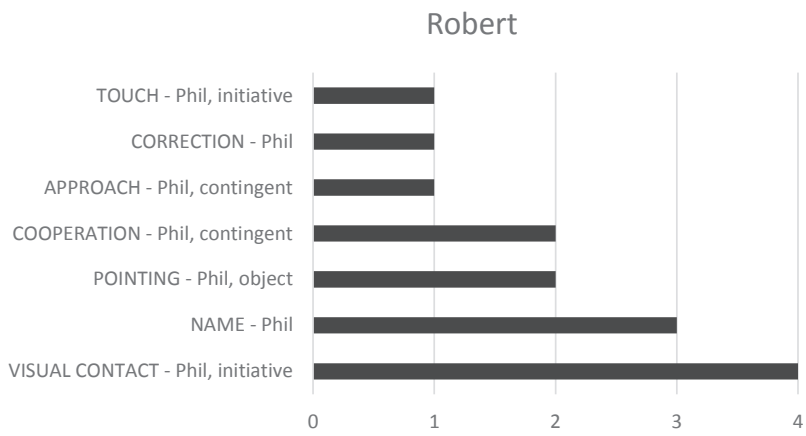

Figure 4. Robert's interaction with Phil

Relation mediated by peers. Because we are referring to a dialogic process, such instances depend on the team's training. The graph below (*Figure 5)* brings out the techniques the professionals used most, and those used by peers who are sufficiently mature and highly empathic.

The principal techniques are focus and attention training on a specific activity, including saying the autist's name, and sometimes including touch. Positive feedback in respect to performance is equally important, which is produced by contingent acknowledgment.

Relation mediated by professionals. Professionals are responsible for creating the conditions to allow Phil, Robert, and their peers to experience instances of cooperation.

As can be seen in *Figure 6*, professionals often repeat the act of naming, as well as of calling attention, and setting forth concrete questions which sustain moments

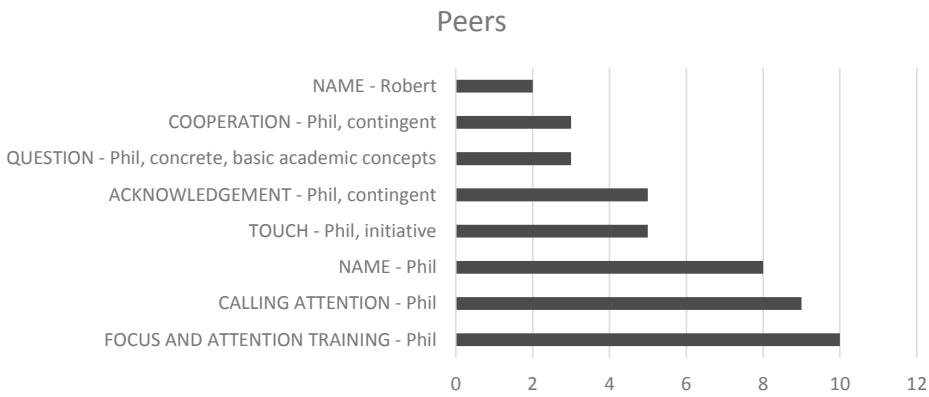

Figure 5. Peer's interaction with Phil and Robert

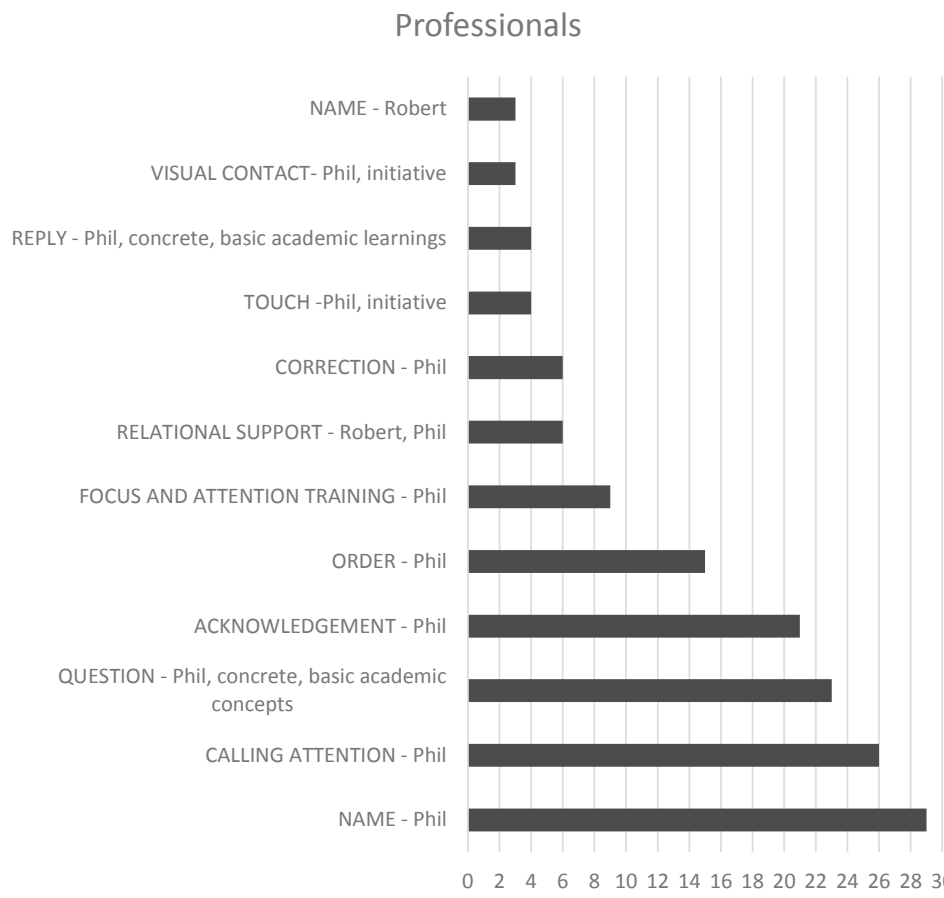

Figure 6. Professionals' interaction with Phil and Robert

of learning, when they are combined with correction and focusing attention on the activity. They also confirm the children's actions and orient the organizing of activities. Relational support is equally important, since it allows the creation of opportunities for cooperative learning.

Phil's reading. The next graph (Figure 7) shows reading activity occurring often, weak reading being the most common. In time, space can be found for more consistent reading, leading to success in involving Phil in the activity, as demonstrated by the frequency of situations in which reading increases to a medium tone, and in some moments, to a strong tone. Initiatives of visual contact coming from Phil start appearing. Nonetheless, such activities are very tiring for Phil, who expresses displeasure, anger, and escape behavior, calling attention to his ZPD.

Cooperation. It is Robert's help which aids Phil in perfecting his reading. He often cooperates, pointing with his finger at the book, showing his intention to help. One can observe (Figure 8) that there were many initiatives by Robert

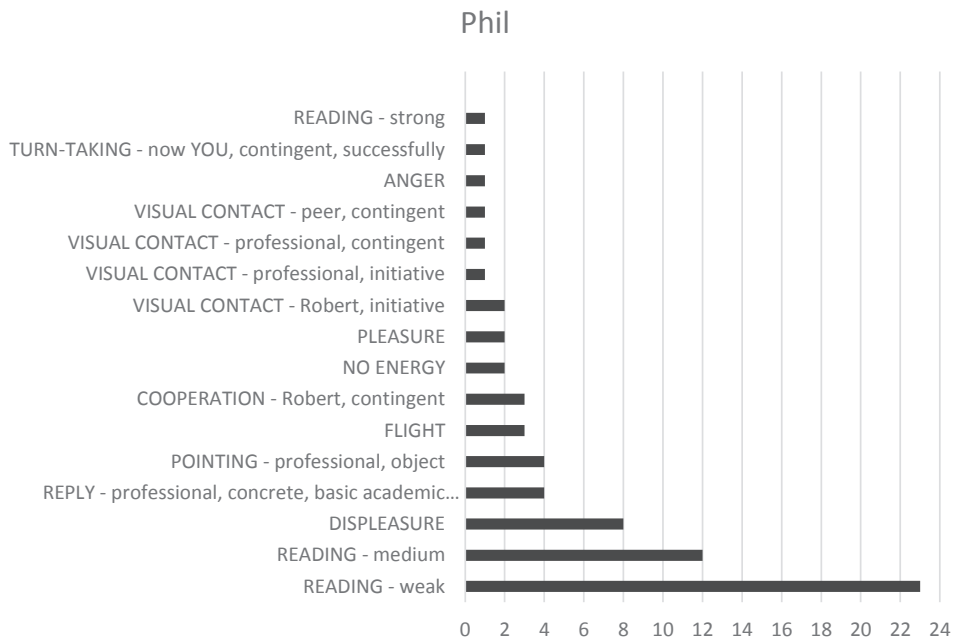

Figure 7. Phil while reading

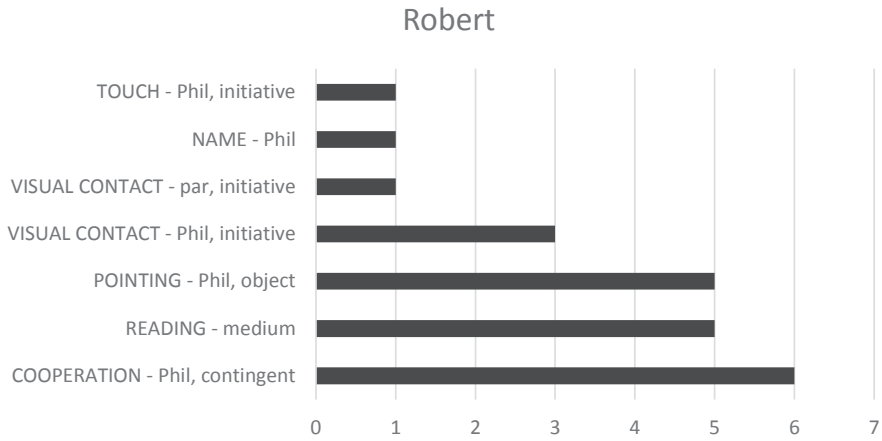

Figure 8. Robert's cooperation with Phil

to establish visual contact with Phil. His example of good reading also motivates Phil to read. As the weeks have gone by, Robert has become a competent peer for Phil.

Peers while reading. The next graph (Figure 9) describes Phil's and Robert's relationships with peers in those instances where reading is occurring. Peers had an important role in motivating both of them. This is brought out when looking

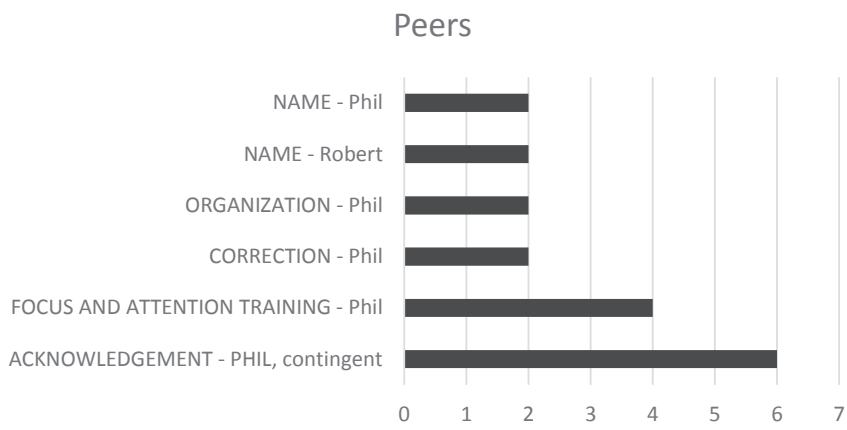

Figure 9. Peer's actions with the intent of creating the cooperative learning moment

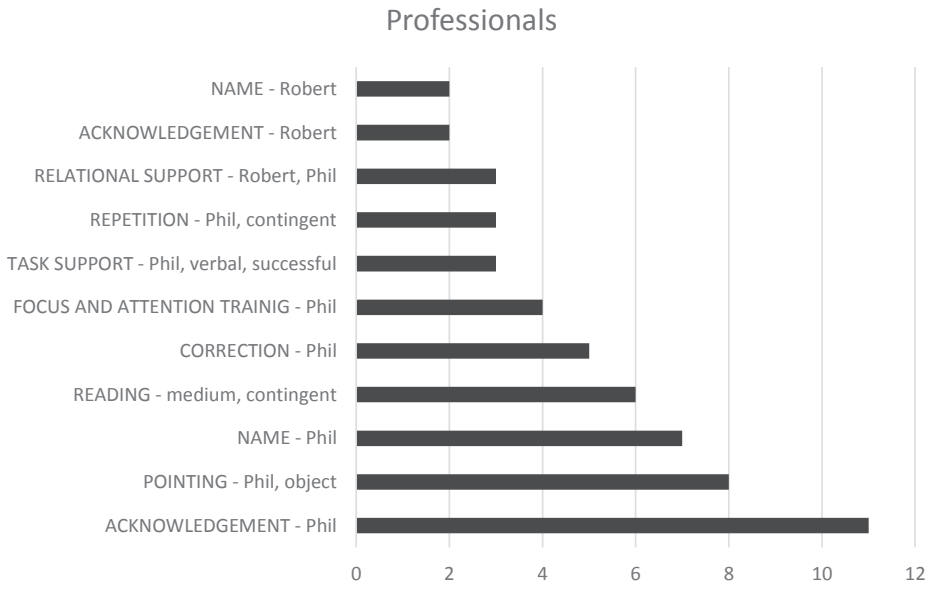

Figure 10. Professionals' actions with intent of creating the cooperative learning moment

at data for confirmation (acknowledgment), focus and attention training, naming Phil and Robert, and the initiative of upholding Phil's acts of reading.

Professionals' action while reading. As shown in Figure 10, success is observed those 11 times when the child's reading activity is confirmed. This rested on techniques of focusing attention through pointing with the finger and saying the name. Relational support between the two is to be noted.

Conclusion

The present paper focuses on specific behaviors intended to identify barriers to be overcome in working with ASD individuals, thus concentrating on the description of the RLS model of intervention. It focuses on two different aspects: the evolution of the team's perception and involvement, and the analysis of a moment of cooperative learning.

Verbal and non-verbal discourse of the professional team

The analysis of the perspective of the professionals and peers at the end of each session underlines the importance of clinical supervision. The results indicate that this activity permits a reflexive attitude toward the set of procedures, and the attitudes which are learned and built in the course of personal, academic, and professional development. This allows continual and constant renovation, amplifying the possibilities for action (Clot, 2006). The construction of consciousness about one's role in the process of humanization of an individual with ASD must be an effective preoccupation during treatment. The dialectic of rehearsal and reformulation of the intervention during supervision allows a scrupulous, and not just spontaneous, work in the task of learning to recongnize and interpret the communicational attempts of an individual with ASD.

The reflection and systematic training of the team permit involvement in, and a conscious rehearsal of, each incidence of decision and hesitation; this makes each intervention a gradually more attentive rehearsal of the relational quality with which one should encounter each individual with ASD.

The relational and motivational quality of intercourse in the learning situation

We believe that learning to read is dependent on contingent responses to the subjects' initiatives, and on adequate levels of mediation, preferably with peers, because they function as figures to identify with in a more spontaneous manner. Reading is an example of the incidence of the importance of social exchange, and, in this case, it makes it possible to compare the efforts of two ASD individuals with different levels of severity of the problem.

The disparity between each member of the group, coupled with the construction of a bond between them, enables the exchange necessary for the autist's acquisition of new concepts and skills, and creates conditions for increasingly independent resolution of problems. In this cooperation, more mature peers provide and lend various tools and goals with which children with ASD get familiar, and then gradually appropriate.

In the excerpt analyzed above, it was observed that double mediation was more efficient than single. Double mediation takes place when the supervisor or other professionals orient competent peers, so that they are the principal figures mediating the autist's learning. Within the playful spontaneity typical of child's play and rehearsal of juvenile relationships, the peers were oriented to integrating themselves in dialogue with the autist, with the result being a unique sharing moment.

Limitations

On-site video recordings, analyzed with a demanding Software Program (Noldus, 2014), have produced a great profusion of data to be further explored in a subsequent paper. In the meantime, one must recognize that the small sample of ASD individuals studied should limit the possibility of generalizing any conclusions.

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Appendix A

Discriminators of the verbal and non-verbal discourse analysis of the professional team

Table 1. Discriminators of the category of self-appraisal

		The interlocutor refers to...
achievement	Negative	not having been able to do something.
	Positive	having been able to do something.
supervision	activity structured in	his own role in an activity structured during supervision.
	need of	having felt the need of supervision, either by saying it or by demonstrating insecurity.
	orientation by supervisor	having received instructions from the supervisor.
	orientation by therapist	having received instructions from another team member.
	Technique	a technique applied by himself that was learned during supervision.
tiredness	–	feeling tired or shows signs of tiredness.
fear	–	feeling fear or shows signs of fear.
surprise	Negative	a situation or characteristic which was a bad surprise.
	Positive	a situation or characteristic which was a good surprise.
joy	–	feeling joy or shows signs of joy.
insecurity	–	feeling unsure or shows signs of insecurity.
liked	Negative	not having liked a specific situation.
	Positive	having liked a specific situation.
expectation	Negative	a situation or characteristic which disappointed previous expectations.
	Positive	a situation or characteristic which surpassed previous expectations.
sadness	–	feeling sad or shows signs of sadness.

Table 2. Discriminators of the category of hetero-evaluation

		The interlocutor refers to...
organization	Negative	an activity or situation considered badly organized by the team.
	Positive	an activity or situation considered well organized by the team.
conflict	–	a conflict between members of the team.
disappointment	–	feeling disappointed about a specific situation or person.
confidence	negative	lack of confidence in the team.
	positive	confidence in the team.
success	negative	lack of success in the realization of something by the team.
	positive	success in the realization of something by the team.
supervision	activity structured in	an activity done by the team that was structured during supervision.
	need of	having felt the need of supervision of the team.
	orientation by supervisor	another team member having received instructions from the supervisor.
	orientation by therapist	another team member having received instructions from another team member.
	technique	another team member using a technique learned during supervision.
expectation	negative	a situation or characteristic which disappointed previous expectations of the team.
	positive	a situation or characteristic which surpassed previous expectations of the team.

Table 3. Discriminators of the category of ASD individuals' description

		The interlocutor refers to an ASD individual...
Dialogic relation		
displeasure	–	having shown signs of displeasure, anxiety, sadness or anger.
pleasure	positive	having shown signs of pleasure.
initiative	negative	not having taken initiative.
	positive	having taken initiative.
verbal communication	negative	having communicated verbally in a way inadequate to the context.
	positive	having communicated verbally in a way adequate to the context.
playing	negative	having been aggressive or having disrespected another person or the rules established while playing.
	positive	having successfully played with someone else.
interaction	negative; peers	having had a bad interaction with a peer/peers.
	negative; therapists	having had a bad interaction with a therapist/therapists.
	positive; peers	having had a good interaction with a peer/peers.
	positive; therapists	having had a good interaction with a therapist/therapists.
cooperation	negative	not having cooperated with somebody.
	positive	having cooperated with somebody.
touch	negative	having rejected touch or being aggressive to somebody.
	positive	having touched someone in order to establish relations with somebody.
visual contact	negative	not having tried to, or being unable to, establish visual contact with somebody.
	positive	having tried to, or being able to, establish visual contact with somebody.
fear	–	having shown signs of fear.
joy	–	having shown signs of joy.
no energy	–	not having had energy for establishing relations.
Cooperative learning		
task support	negative; peers	not having been able to support a peer/peers in a task.
	negative; therapists	not having been able to support a therapist/therapists in a task.
	positive; peers	having been able to support a peer/peers in a task.
	positive; therapists	having been able to support a therapist/therapists in a task.

learn	negative; basic academic concepts	not having been able to learn basic academic concepts.
	negative; daily concepts	not having been able to learn daily concepts.
	positive; basic academic concepts	having been able to learn basic academic concepts.
	positive; daily concepts	having been able to learn daily concepts.
teach	positive; basic academic concepts	having taught basic academic concepts to somebody else.
	positive; daily concepts	having taught daily concepts to somebody else.
rules	negative	not having followed the established rules.
	positive	having followed the established rules.
attention	negative	not having paid attention.
	positive	having paid attention.

Appendix B

Discriminators of behavioral analysis

Table 1. Discriminators of the category of motor reflexes

	The action's agent...
attention	has his attention focused on somebody or a specific task.
approach	approaches somebody or something.
aggression against others	has aggressive behavior towards somebody.
kiss	gives somebody a kiss.
yawn	yawns.
hug	hugs somebody.
babbling	emits a sound without a verbal meaning.
transitional object	has repetitive behavior with an object.
handling	handles an object.
playing alone	plays alone.
body	explores somebody's body.
touch	touches somebody.
flight	has flight behavior.
visual contact	seeks or establishes visual contact with somebody.
pointing	points at somebody or something.

Table 2. Discriminators of the category of verbal reflexes

	The action's agent...
acknowledgment	gives positive feedback to an ASD individual.
reading	reads.
name	says the name of an ASD individual.
calling attention	calls somebody's attention.
order	gives an order to somebody or the group.
naming	names or describes an object, person or situation. It can be concrete (accessible to the individual with autism) or abstract (not accessible to the individual with autism).
question	poses a question. It can be concrete (accessible to the individual with autism) or abstract (not accessible to the individual with autism).
reply	gives an answer. It can be concrete (accessible to the individual with autism) or abstract (not accessible to the individual with autism)

Table 3. Discriminators of the category of relational behavior

	The action's agent...
calming	calms somebody.
spontaneous contingency	is spontaneously contingent.
imitate	imitates somebody.
turn-taking	passes the turn to somebody during an activity.
requests for help	asks for help.
isolated	is isolated.
seeking for relation	intentionally or unintentionally seeks a relationship with somebody.
proposal for activity	proposes an activity to somebody.
cooperation	cooperates with somebody.
playful acts	plays with somebody.

Table 4. Discriminators of the category of techniques

	The action's agent...
contingency	is intentionally contingent with an ASD individual.
transmit security	behaves in a supportive and cherishing way, both physically and emotionally transmitting the message "I am here for you".
turn-taking (technique)	passes the turn to a ASD individual during an activity aiming to create a dialogic relationship which is pleasurable for the ASD individual. The purpose is to recreate the pattern of action "now-I-now-you-now-I".
ZPD correction	corrects a mistake committed by an ASD individual.
ZPD task support	supports the accomplishment of a specific task when it seems to be too hard for the ASD individual to accomplish on his/her own.
ZPD negotiation	negotiates the terms of realization of a task with an ASD individual so that it is accomplished, even if the ASD individual perceives it as difficult or impossible to accomplish.
Eigenwelt	takes on the *Eigenwelt* of an ASD individual.
organization	organizes the group, or one of its members, in a specific task.
emotional echo	names emotions and feelings transmitted or described by the ASD individual without being conscious of it. The goal is to obtain apprehension of feelings in respect to things, people and/or events.
relational support	incentivizes an ASD individual to interact with one or more elements of the group or vice-versa. This may come as a direct order/request/invitation or as a subtle change in focus of the group in a way that includes a member who is isolated at the moment. This is intended to promote mutual attention, or the ability of the individual to be an integral part and cooperate with the group.

generalization	conveys that a specific experience of the ASD individual is typical of the human condition, reducing anxiety in moments of distress.
repetition	repeats a sound, word or phrase emitted by the ASD individual. Should be limited to that which has communicational value, so that the increase in verbal production may have an increasing communicational effect and may feed the dialogic relationship.
attention and focus training	guides the ASD individual in a way it helps him remember constantly where his attention's focus should be at a specific moment (e.g., pointing at something).

Table 5. Discriminators of the category of emotion/feeling

	Description
insecurity	Demonstration of insecurity.
anxiety	Demonstration of anxiety or impulsiveness.
anger	Demonstration of anger.
pleasure	Demonstration of pleasure, enthusiasm or joy.
displeasure	Demonstration of displeasure, tiredness, sadness, pain, fear or insecurity.
curiosity	Demonstration of curiosity or expectation.

Appendix C

Table 3 extended. Discriminator frequencies of the self-appraisal category (Extended Table*)*.

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	*f*
Liked (+)	18	17	30	18	16	21	23	9	4	16	9	15	8	33	7	11	9	12	21	10	**307**
Insecurity	16	15	18	12	14	11	4	4	**4**	**35**	13	6	6	8	3	11	7	**1**	7	10	205
Achievement (+)	4	16	12	5	6	4	5	3	0	**20**	**9**	2	2	3	0	5	4	1	4	5	110
Tiredness	6	8	4	4	5	3	3	3	3	**9**	**9**	5	3	4	2	4	3	1	6	4	89
Supervision need	13	9	6	1	5	2	1	1	2	**11**	6	**3**	3	4	3	4	4	**0**	0	1	79
Joy	4	4	10	5	7	3	4	3	0	7	0	2	1	3	0	2	1	2	2	1	61
Achievement (–)	2	4	6	5	4	3	4	1	0	**9**	0	1	0	3	0	5	3	2	0	3	55
Expectation (+)	3	4	4	3	1	1	0	2	0	5	2	0	3	8	1	0	2	0	4	3	46
Expectation (–)	6	2	0	0	1	3	3	0	1	**7**	1	1	0	0	0	0	0	0	4	2	31
Liked (–)	1	2	2	6	0	2	1	2	0	1	0	1	1	2	1	0	5	0	2	1	30
Structured activity supervision	1	3	1	1	1	0	1	0	0	**4**	1	1	2	3	1	1	1	0	0	0	22
Fear	0	1	1	0	0	0	0	2	0	2	2	2	1	0	0	1	1	0	0	0	13
Sadness	0	0	0	0	0	1	0	0	0	1	1	1	0	0	4	0	0	0	0	4	12
F	74	85	94	60	60	54	49	30	14	**127**	53	40	30	71	22	44	40	19	50	44	

Appendix D

Table 4 extended. Discriminator frequencies of the hetero-evaluation category (Extended Table*)*.

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	*f*
Success (+)	3	8	22	16	15	9	26	11	6	17	4	15	4	15	2	8	7	10	26	24	**248**
Confidence (+)	1	4	13	8	6	4	14	5	4	10	3	2	1	6	3	1	1	4	4	2	96
Organization (-)	5	6	2	0	2	1	0	2	**0**	**16**	5	3	3	5	1	8	**29**	**0**	7	0	95
Organization (+)	2	3	14	9	6	3	11	1	4	6	2	4	1	4	2	3	0	5	2	3	85
Supervision need	9	4	6	1	1	1	1	3	**0**	**8**	5	5	2	2	1	6	**12**	**1**	1	2	71
Supervision activity structured	0	2	1	2	0	0	3	1	**2**	**6**	2	2	1	1	3	**7**	**12**	7	7	5	64
Success (–)	3	2	6	1	0	0	2	0	0	4	1	0	0	2	0	2	4	0	0	1	28
Expectation (+)	1	1	3	1	1	1	5	1	1	3	2	1	0	1	0	3	1	0	2	0	28
Confidence (–)	0	0	2	1	0	0	0	0	**0**	**4**	1	2	1	0	1	1	**10**	**0**	0	0	23
Disappointment	0	2	1	1	0	1	2	1	0	2	2	0	1	1	0	0	1	0	0	0	15
Expectation (–)	1	3	0	2	0	1	2	0	**0**	**4**	1	1	0	0	0	0	0	0	0	0	15
f	25	35	70	42	31	21	66	25	17	80	28	35	14	37	13	39	77	27	49	37	

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Personality attributes of children with behavior problems. An exploratory analysis with the Exner Comprehensive System of the Rorschach Inkblot Test and implications for the socio-historical clinical practice approach

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From a Relational-Historical theoretical framework applied to clinical psychological practice, this study examines the data set underlying the personality attributes of different groups of children with behavior problems as demonstrated on the Rorschach Inkblot Test. To define the groups, categories were established from parents' descriptions of their own children. This procedure allowed for the formation of three major psychological profiles: hyperkinetic, oppositional defiant, and antisocial (Saraiva & Ferreira, 2016). The major goal of this study is data exploration in a clinical setting, in order to investigate whether and in what ways groups of hyperkinetic, oppositional defiant, and antisocial children differ. These profile characteristics are important issues embraced by both psychodiagnosis and psychotherapy. The participants for this study were 39 Portuguese children, who were private clinic clients; there were 24 boys and 15 girls between the ages of 6 and 14. Their personality attributes were measured using the Rorschach Inkblot Test (Rorschach, 1994), and the Comprehensive System developed by Exner (1991, 1993, 2000) was applied, with the support of the clinical interpretation provided by Quintino-Aires (1999; 2009; 2012; 2014). Comparison of the three profiles showed four common aspects of personality structure: a deficit in cognitive perceptual skills, lack of self-control, limited relational skills, and low self-esteem. Differences in the three profiles revealed factors related to the functional characteristics of specific behavior patterns. Children with the hyperkinetic psychological profile show factors of difficulty in controlling their activity, impulsivity, and overlapping emotions about conscious action. Those with the oppositional defiant profile revealed factors of low self-confidence, low trust in others, high pessimism, loneliness, and structural stress. Finally, those with the antisocial profile had factors of a deficit in coping skills, lack of verbalization of affects and emotions, and egotism.

Keywords: hyperkinetic, oppositional, antisocial, Exner Comprehensive System for the Rorschach Inkblot Test, postnonclassical psychology

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Introduction

Disruptive behavior disorders are among the easiest of mental health childhood disorders to identify because they are expressed through objective behaviors such as tantrums, aggression, excessive argumentativeness, stealing, and other forms of defiance or intolerance to authority. Disorders like oppositional defiant disorder (ODD) and conduct disorder (CD) first attract notice when they interfere with academic performance, or family and peer relationships. Behaviors typical of disruptive disorders can have some resemblance to attention-deficit/hyperactivity disorder (ADHD) — particularly when impulsivity and hyperactivity are also involved — but ADHD, ODD, and CD are considered separate conditions that can occur independently (APA, 2013; OMS, 1996).

Both the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-5), and the International Statistical Classification of Diseases and Related Health Problems, 10th Edition (ICD-10) have established diagnostic criteria for ADHD, ODD, and CD. A comparison of the two diagnostic approaches finds slight discrepancies between the two. *Table* 1 presents the structure of classification and respective codes regarding these behavioral disorders.

North American studies have estimated the prevalence of early childhood behavioral disorders, but numbers can vary significantly from study to study, depending on the purpose, methodology for population selection, and criteria used to diagnose the disorders and identify functional impairment. The results of these studies indicate that about one out of every three to four youths is estimated to meet the lifetime criteria for a DSM mental disorder (Costello et al, 2004). After anxiety disorders, considered the most frequent condition in children, ADHD is the most common neurobehavioral childhood disorder as it affects large numbers of children throughout the world (Solovieva & Quintanar, 2015). As previously noted, there is also no agreement on the prevalence of ADHD. Nevertheless, a Spanish study reveals a range of incidence from 1.5% to 18% in different populations (Cardo, 2010); another study estimates that approximately 5.29 % meet the criteria for ADHD (Polanczyk et al., 2007). According to the DSM-5, the annual prevalence of CD is 2% to 10%, with a median of 4% (APA, 2013). ODD has an estimated lifetime prevalence of 10.2% (Dickstein, 2010).

Considering the previously cited psychopathological diagnostic classifications for which there are generally agreed-upon definitions, it is important to discuss and develop the concepts that the study addresses. DSM-5 has recently reclassified ADHD from "Disorders Usually First Diagnosed in Infancy, Childhood or Adolescence" to "Neurodevelopmental Disorders." ADHD is a behavioral condition that makes focusing on everyday requests and routines especially challenging. Children with ADHD typically have trouble organizing tasks and activities, fail to pay attention to details, are unable to remain seated in appropriate situations, and find it difficult to stay focused, make plans, and consider the consequences of their actions. Excessive talking, fidgeting, noisiness, difficulty playing quietly, and problems adapting to changing situations represent another set of symptoms. It is common to subdivide the disorder into two groups — inattention and hyperactivity/impulsivity — both having to be consistent to a degree that is maladaptive and inconsistent with the child's developmental level (APA, 2013). Children with ADHD can also be defiant, socially challenging or aggressive, and there is known

Table 1. Comparison between the taxonomy of the DSM-5 and ICD-10

DSM-5	ICD-10
Attention-Deficit/Hyperactivity Disorder (314.01) Category: Neurodevelopmental Disorders Code 314.00 Predominantly inattentive presentation Code 314.01 Predominantly hyperactive/impulsive presentation	Attention-deficit hyperactivity disorders (F90) Code F90.0 Attention-deficit hyperactivity disorder, predominantly inattentive type Code F90.1 Attention-deficit hyperactivity disorder, predominantly hyperactive type Code F90.2 Attention-deficit hyperactivity disorder, combined type Code F90.8 Attention-deficit hyperactivity disorder, other type Code F90.9 Attention-deficit hyperactivity disorder, unspecified type
Conduct disorder (312.81) Code 312.81 Conduct disorder, childhood-onset type Code 312.82 Conduct disorder, adolescent-onset type Code 312.89 Conduct disorder, unspecified onset	Conduct disorder (F91) Code F91.0 Conduct disorder confined to family context Code F91.1 Conduct disorder, childhood-onset type Code F91.2 Conduct disorder, adolescent-onset type Code F91.3 Oppositional Defiant disorder Code F91.8 Other Conduct disorders Code F91.9 Conduct disorder, unspecified
Oppositional Defiant disorder (313.81)	

co-morbidity and premorbidity between ADHD and ODD (Pardini & Fite, 2010). ADHD has been reconsidered in the latest edition of the DSM, so that it now features three different types: the predominantly inattentive type; the predominantly hyperactive-impulsive type; and finally, the combined type, when both core symptoms coincide (APA, 2013).

The concepts of CD and ODD draw from psychopathology and characterize two kinds of antisocial behavior that are clinically significant (Kazdin & Whitley, 2006). The inclusion of a chapter on disruptive, impulse-control, and conduct disorders is new to the DSM-5; it includes Oppositional Defiant Disorder (ODD), Conduct Disorder (CD), and Intermittent Explosive Disorder. According to DSM-5 criteria, CD is characterized by behavior that violates either the rights of others, or age-appropriate societal norms or rules. The essential feature is a repetitive and persistent pattern, and the symptoms must cause significant impairment in social, academic, or occupational functioning. The disorder is typically diagnosed prior to adulthood. CD may also be described as juvenile delinquency in criminal taxonomy, where both psychological and legal definitions are combined. It is also well

established that CD can be a premorbid condition for Antisocial Personality Disorder (APD), as in adult criminality, especially when lack of empathy and deficient affect are fundamental traits.

The symptoms of ODD are now grouped into three types: angry/irritable mood, argumentative/defiant behavior, and vindictiveness (APA, 2013). Broader labels such as disruptive, challenging, or troublesome may encompass both CD and ODD, reflecting the impact that the behavior has on disturbing the social environment. Whatever the case may be, a child behavior disorder consists of a marked pattern of social impairment and maladjustment that results in repetitive acting-out behavior, not just in an isolated incident.

The present study decided on an alternative terminology — behavior problem — as it offered a wider definition and subsumed a variety of behaviors. To put the subtypes of pattern behaviors into focus, a broader taxonomy was adopted, namely the hyperkinetic, oppositional defiant, and antisocial behavior profiles.

Regardless of the difficulties hyperkinetic children may display, specifically in close relationships like those with family members or schoolmates and teachers, few attempts have been made to understand the relationship between specific features of hyperkinetic behavior and socio-emotional functioning, using standardized tests like the Rorschach Inkblot Test (Cotugno, 1995). When associated with the Exner Comprehensive System, the Rorschach provides useful data on a wide range of personality attributes, and important insight into personality structure and the complex relationship between behavioral patterns and the effect of these on socioemotional functioning. It is clear that the Rorschach test should not be the only instrument used, but an important part of an overall psychological evaluation. In fact, the Rorschach test is a vital complement to more standardized and even survey instruments, and neuropsychological investigation should play a leading role in any rigorous clinical evaluation (e.g., Akhutina & Pylaeva, 2011; Kholodnaya & Emelin, 2015; Solovieva & Quintanar, 2015; and others).

The aim of this study was to examine the data set underlying personality attributes as demonstrated on Exner's Rorschach Comprehensive System in children labeled with hyperkinetic, oppositional defiant and antisocial profiles. For accomplishing this main objective, similarities and differences in personality attributes of the three groups were analyzed. Results are presented and discussed in light of the cultural-historical perspective (Luria, 1973; Vygotsky, 1993) and the specific clinical interpretation of the Quintino Aires Institute (Quintino-Aires, 1999; 2009; 2014).

Perspective of the Vygotsky-Luria school

When looking into the philosophical science that dominates human science's conceptualization and methodology, particularly about psychology, one realizes that classical Western thinking, following Cartesianism, provides theories and paradigms that emphasize fragmentation and compartmentalization of knowledge about mind and body. This conception defines the direction and still underlies observations and practices of dealing with child behavioral problems. Contemporary psychology, based on philosophical science, has provided the foundation for the classification of scientific approaches, leading to an actual state of scientific knowl-

edge characterized by the concept of postnonclassical science (e.g., Pervichko & Zinchenko, 2014; Quintino-Aires, 2014; Zinckenko & Pervichko, 2012; 2013).

Hyperactivity, as in ADHD, is a relatively recent historical category in child studies. In contemporary clinical psychology supported by the Vygotsky-Luria school, syndrome analysis is one of the most essential methodological principles used for dealing with complex self-developing open systems and studying psychic phenomena like personality attributes (Luria, 1973; Vygotsky, 1993; Zinchenko & Pervichko, 2012). The conceptualization of a particular type of syndrome is essential to structural analysis of complex phenomena, to clarify the distinction between the manifestation of psychological factors and the mechanisms responsible for their emergence and functioning. As Zeigarnik's works show, this enlightenment benefits the psychological interpretation of clinical phenomenology (Nikolaeva, 2011).

Method

Sample

Our sample comprised 39 Portuguese children, 24 males and 15 females, of ages between 6 and 14. These children were selected from a group of clinical patients at a Portuguese Health Institute which has applied the Historical-Cultural approach for many years. Children with behavior problems were classified into three groups: "hyperkinetic," 20 children (51.3 %); "oppositional defiant," 11 children (28.2 %); and "antisocial," 7 children (20.5 %).

The assignment of children to each group was done according to three criteria: a) the description by the family members who accompanied the children to the first consultation, usually the parents; b) interaction with the child in the first consultation; and c) the assessment made by senior psychologists using neuropsychological investigation with a Lurian battery (BIN, Neuropsychological Research Battery; Juvêncio, 2015; Rua, 2015) and a personality assessment with Rorschach Inkblot Test. This psychodiagnostic methodology is traditional for historical and cultural psychology, and it is an alternative to the psychometrical and cognitive approach.

Table 2. Descriptive data for age in the three groups

	Range	χ	SD
Hyperkinetic (H)	6-12	8.94	1.92
Oppositional Defiant (OD)	6-12	9.91	1.81
Antisocial (AS)	6-14	9.88	2.80

The Rorschach Test was administered and scored by examiners formally trained in the use of Exner's Comprehensive System (1991, 1993, 2000). Clinical case notes provided a picture of the client's reports on the child's behavior at home and school, the client's reasons for entering therapy, the child's current symptomatology, and his/her clinical diagnosis. The data collected was analyzed by four judges with training and practice in clinical psychology, who discussed the meaning of the children's behavior reported by parents, and the results of their assessment.

Three clinical groups were organized according to the criteria proposed by the classification systems of psychological disorders (ICD-10 and DSM-V). Hyperkinetic (H) signified "hyperactivity, agitation, restlessness, low concentration, lack of attention." Oppositional Defiant (OD) signified "oppositional, defiant, rudeness, disobedience, resistance." And antisocial (AS) signified "lying, running away from school/home, abuse, aggressiveness, unruliness." In *Tables* 2 and 3 we report the age and gender distributions for the children from the three groups.

Table 3. Frequency of gender in the three groups

	H	OD	AS
Male	13	4	7
Female	7	7	1

Because of the exploratory nature of this study and considering the size of the sample, test differences in age and gender were not analyzed. Nevertheless, age averages were considered similar, and some differences in gender distribution of the three clinical groups were registered, particularly in the antisocial sample, which consisted of only one female.

Instruments

The goal of identifying personality attributes of several groups with behavior problems was pursued using the Exner Comprehensive System of the Rorschach Inkblot Test (1991, 1993, 2000). The Rorschach Inkblot Test is a projective technique composed by 10 psychodiagnostic plates with abstract stimuli made of inkblots. Upon observing each plate, individuals have to express what the ink spots resemble. The Exner Comprehensive System allows a broad picture of the psychological dynamics of the individual. This system evaluates the personality structure to three groups of key variables: Group I — the Perceptual-Thinking Index (PTI), the Depression/Apathy Index (DEPI), and the Coping Deficit Index (CDI); Group II — control and tolerance of stress; and Group III — dominant styles (or trends) of personality, namely, affective features, self-perception, and interpersonal perception. The three groups of different indices are used for the calculation of three groups defined by qualities of mental functioning: The «cognitive triad» refers to information processing, ideation, and cognitive mediation.

All results obtained in this study are presented and discussed in light of the clinical interpretation provided by Quintino-Aires (1999; 2009; 2012; 2014). This author provided maladaptation and clinical-reference values, and a clinical-oriented interpretation for the variables, chapters, and constellations of the Exner Comprehensive System, in order to obtain an individualized understanding of the patients.

Procedure

In order to provide a uniform coding procedure among the psychologists, data was collected through standard evaluation procedures by clinical psychologists of a health institution certified in Rorschach administration and Exner Comprehensive

System procedures. Data was analyzed with SPSS.20. Coding of the Rorschach protocols had an agreement coefficient of 0.95 among four independent judges with training in clinical psychology.

Results

In general, the Rorschach constellations did not indicate psychopathology for either group, but the Depression/Apathy Index (DEPI) was considered clinically significant in all three profiles. *Table* 4 illustrates the first findings on major constellations. In line with Exner's (1993) recommendations, singular variables were not reviewed, but were considered in groups of variables or clusters, relating each other to specific characteristics of personality. We further analyzed similarities and differences in the results between the groups.

Table 4. Means of major constellations

	H	OD	AS
PTI	2.85	2.00	2.13
DEPI	3.85	3.55	3.63
CDI	3.05	3.55	3.38
SCON	5.20	4.91	5.38

Table 5. Frequency of major constellations with abnormal values (%)

	H	OD	AS
PTI	30.0	18.2	25.0
DEPI=3	35.0	36.4	37.5
DEPI>3	60.0	54.6	50.0
CDI	15.0	27.3	0.0
SCON	5.0	0.0	12.5

Neither the Hypervigilance Index (HVI) nor the Obsessive Style Index (OBS) were present, and, hence, were not considered in the previous tables. The most significant indicator was that all three groups had a DEPI mean greater than 3; this is explained by the fact that 50% or more of each group had a DEPI higher then 3 (4 or higher).

The comparison of profiles shows common aspects in four dimensions: cognitive/perceptual skills, self-regulation, relational skills, and self-esteem. As to the first dimension, cognitive/perceptual skills, in all three groups a marked deficit in the reception, interpretation, and meaning of stimuli arising from experiencing the environment was found (W). This deficit directly influences the style of approaching the world, expectations, and resources (W:M) and, in a broader sense, processing. Cognitive mediation was also impaired, namely self-awareness and awareness of others (X+, F+); there was a difficulty in starting relationships with others (X-),

and a tendency for defensiveness (Xu). When ideation was considered, a lack of cognitive flexibility (a:p) was found. *Table* 6 presents values of indicators for these dimensions.

Table 6. Frequency of Rorschach indicators with abnormal values (%)

		H	OD	AS
Processing	Tendency W	90.0	36.4	75.0
	Tendency Dd	0.0	27.3	25.0
	Both tendency W and Dd	0.0	27.3	0.0
	W<M+50	40.0	54.5	37.5
	W>M+100	45.0	36.4	62.5
	DQv	50.0	72.7	37.5
Mediation	P	75.0	72.0	50.0
	X+	100.0	100.0	100.0
	F+	95.0	100.0	100.0
	X-	90.0	81.8	87.5
	S-	50.0	27.3	25.0
	Xu	100.0	90.9	87.5
Ideation	a<p+2	45.0	27.3	37.5
	a>p+2	45.0	63.6	50.0
	M-	30.0	33.4	12.5
Affect	F : C	70.0	72.7	62.5
	PureC	30.0	18.2	37.5
	Comb:R	75.0	90.9	87.5
Self-perception	3r+(2)/R	75.0	90.9	75.0
	Fr+rF	5.0	9.1	12.5
	FD	90.0	72.7	87.5
	MOR	35.0	45.5	12.5
Interpersonal	COP	85.0	90.9	87.5
	AG	85.0	90.9	100.0
	H:(H)+Hd+(Hd)	95.0	100.0	87.5
	(H)+(Hd):(A)+(Ad)	20.0	36.4	75.0
	(Bt+2Cl+Ge+Ls+2Na)/R	40.0	72.7	50.0
Control	EA	35.0	54.5	25.0
	es	75.0	72.7	100.0
	Adj es	75.0	63.6	100.0
	FM < 3	65.0	45.5	62.5
	FM > 4	20.0	18.2	12.5
	C’	70.0	27.3	75.0

The second dimension evinced a deficit in self-control, poor elaboration (FM), precipitate judgement of others (H:(H)+Hd+(Hd)), and lack of self-analysis (FD). The third dimension concerned relational skills, where low levels of empathy (Comb:R) were observed, an impairment in cognitive mediation, difficulties in bonding (COP), low assertiveness (AG), and a failure to have an accurate representation of others due to hasty judgment (H:(H)+Hd+(Hd)). The fourth dimension that all three groups had in common was related to self-esteem (3r+(2)/R). All participants showed low self-esteem and social identity, and this was associated with a lack of resources and expectations (W:M), sadness, and general lack of energy (DEPI).

But different aspects were also found when comparing all three profiles in relation to the functional characteristics of each behavior pattern. Within the Hyperkinetic (H) group, the children had difficulty regulating action (F:C), were more impulsive, and their emotions overrode conscious reflexive action (PureC).

Children with an Oppositional Defiant profile (OD) had a higher lack of trust in themselves and others (3r+(2)/R); in this case, low expectations (W:M) and resources (EA), higher pessimism (MOR), loneliness ((Bt+2Cl+Ge+Ls+2Na)/R), and intrinsic stress were the important distinguishing variables (Adj es). Another core aspect of this profile is that relationships with others and the environment are more difficult (COP, AG; (H:(H)+Hd+(Hd)), and more tense. There is a restriction in these children's ability to focus, as they have low involvement, less conventionality (P), less flexibility (a:p), and low awareness of themselves and others (S-). Disturbance of thought also plays a key role (M-), with higher susceptibility to the environment due to a lack of self-organization (DQv).

Children in the Antisocial (AS) group had a greater deficit of resources for positive relationships, and a lack of resources to deal with stress (EA), like coping skills; in this sense they registered intrinsic stress (Adj es). This group also revealed a deficit in organizing internal information, difficulty in verbally expressing emotions and feelings (C'), cognitive rigidity (a:p), a tendency to use a great deal of fantasy in representation of others ((H)+(Hd):(A)+(Ad)), and to a global approach to the world (W). Another set of characteristics of this group related to the bias in self-representation, because greater egotism was present, less disposition for self-analysis (FD), and lower expectations about their own resources (EA).

Discussion

The findings in this study allow a glimpse into hypothetical scenarios of the dynamic structure of personality profiles, namely the relation to one's self, others, and the world within a specific, unique, and singular *Eigenwelt*. The predominance of problems of self-control, precipitate judgment, and overlapping conscious emotions characteristic of the Hyperkinetic profile involved more motor and affective features needing rehabilitation of the ability to control and plan action with important psychomotor characteristics. Neuropsychological rehabilitation, or even working with play therapy with a focus on shared attention, will introduce the regulation of alternating communication through joint action (Leal, 2010).

The Oppositional Defiant profile showed less self-confidence, less trust in others, higher pessimism and loneliness, low resources and expectations, and rather

tense relationships. This showed a need for self-awareness through knowing the other. Rehabilitation should be centered in more dialogue, and the experienced "other" should function as a vehicle for consensual meaning, by putting together, naming, and referencing the process.

The Antisocial profile registered a lack of resources to deal with stress, difficulty in expressing emotions and feelings, and egotism. The interpretation of this profile provides us with a need for feeling the other, knowing that the other exists, and finding the limits in one's self. Confrontation, a work routine, and clear boundary setting are needed in therapy.

In clinical practice, hyperactivity can often be a behavior pattern intersecting all three profiles. Aggression is also a behavior that can often be manifest in all of the profiles. Differential diagnosis is essential when dealing with these syndromes, and specific considerations regarding treatment need to be made if serious work is to be pursued (Solovieva & Quintanar, 2015). Finally, an important aspect of the Oppositional Defiant and Antisocial profiles concerns the underlying intentionality behind the behavior. Both can be seen as defiant patterns of behavior, but while Oppositional Defiant types manifest reactive and non-intentional aggression, Antisocial types present instrumental and intentional aggression.

Conclusion and future directions

With these findings, one can further develop Leal's (1988) proposed psychopathological system based on the Genetic Affectology theory that presents seven stages of socio-emotional development. To some extent this rationale also has points of similarity with Elkonin's leading activity concept (Quintino-Aires, 2014).

Quintino-Aires (2014) argues:

> "Steps of Genetic Affectology", by Maria Rita Mendes Leal, serve as the "grammar," *morphology* and *syntax* of personality that allow us to listen/read with sense the *phonemes* produced by the patient, which are then the symptoms expressed in actions and speech. (p. 42)

This exploratory study with groups of children with behavior problems is an example of how syndrome analysis can be used. But further research with larger samples and quasi-experimental designs could help diagnosis and provide guidelines for making clinical psychological prognoses and suggesting therapeutic plans for each particular client. Further research could also have a focus on testing parental and school environment variables in longitudinal studies and revisit the way ADHD is approached, considering the historical and cultural influence on meanings when diagnosing and treating difficult children.

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Prospects for development of L.S. Vygotsky's ideas in clinical psychology

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This work is dedicated to the development of L.S. Vygotsky's ideas in clinical psychology and the clarification of some basic points of the cultural-historical concept. The paper presents a thesis about the development of man in ontogeny as the result of his interaction with the cultural environment, which transforms natural mental functions into higher mental functions. This process can be attended by a whole range of psychopathologies. The issues discussed include voluntary regulation of higher mental functions, determination of the involuntariness and "post-voluntariness" of functions, the internalization of actions, the differentiation of affect and emotion (including as higher mental functions), the "cultural" socialization of non-mental functions (sex, sleep, excretion), and the discord between natural and "cultural" entities in a person. The basis for the ontological development of man is the genesis of "subjectness", like all the forms of higher activity that emerge when encountering cultural restrictions and requirements causing specific mental disorders. The supposition is made that there are no significant restrictions to explaining either mental or non-mental functions with the cultural-historical approach. Recommendations for further research are suggested.

Keywords: cultural-historical concept, development in ontogeny, voluntary regulation, internalization, higher mental functions, a "cultural" body

While schematizing the classical concept of higher mental functions in order to present its key points, we affirm that human development itself is a result of a person's interaction with his cultural environment. This transforms innate, natural mental functions into higher mental functions, through the child's adoption and subsequent internalization of special tools that are social in origin. These are formed in direct contact with an adult, through interpersonal (shared) activity. This interpersonal activity is actualized in an object-centered, real form, but internalization turns it into a concealed, unobserved form, mediated by a psychological tool — a sign — not directed at external objects at first, but rather at control of other people, and then also of the child's own behavior. The principal differences between higher mental functions and natural ones consist in the capacity of the former for self-regulation; their lifelong generation, social origin, the mediation of their formation

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by a psychological tool or sign; their voluntariness; and awareness that is achieved by their functioning; their hierarchical and systemic nature (Luria, 1969).

The distinction between the hierarchical positions of lower (natural) and higher mental functions is primarily because there is a new intermediate element interposed between the stimulus (toward which behavior is directed) and the person's response. Behavior loses its unmediated character, and the unity of stimuli and responses is disrupted. The scheme of the formation of higher mental functions introduced by L.S. Vygotsky (1982) has been reproduced with almost no alterations in later psychological works following his cultural-historical approach, although some of its basic theses require clarification.

The problem of voluntariness (or in its philosophical meaning, "volition") remains especially unclear, and has been one of the most difficult things to explain throughout the history of philosophy and psychology. Voluntariness still has no unambiguous meaning, as there remains the absolutely unintelligible moment of joining the incorporeal substratum of will to a material body. Any possible solution faces the unsolved psychophysiological problem. A possible way around it that Vygotsky uses is the idea of sign-symbol mediation — a universal instrument adopted during ontogeny, which enables one to master one's own behavior by mastering the stimuli controlling that behavior. This idea, borrowed from Hegel, was intended to explain the possibility of affecting real behavior by means of the incorporeal substratum of will. Hegel employed the metaphor of the "cunning" of reason, not interfering with the actions of natural forces, but allocating them in a sequence that corresponds to the will of the subject, without any violation of natural laws (Hegel, 1997). For instance, the existence of an airplane in no way violates any law of nature; however, there are no airplanes in nature: They are the invention of humankind. Though there is no "natural airplane", the machine was invented in full accordance with laws of nature (and these laws allow it to function, so that human beings can perform an act incompatible with their nature: to fly). Although the laws of nature are not violated, the result is a completely unnatural event. A real stimulus, which later on evokes the required behavior**,** may be replaced by its semiotic copy or signifier, thus representing the stage of transition to sign-symbol mediation.

This is what Vygotsky considers a specifically human invention, although, as Hegel does in his metaphor of the "cunning" of reason, Vygotsky underscores that there are no cultural practices that could not be separated into their constituent natural processes. The principal limitation of that explanation is that releasing the will from the necessity for material effort does not completely clarify the problem of choice: After all, the problem is not that the will is unable to lift a stone, but that muscular strength is needed to do it. Force ceases to be measured in kilograms, but it remains unclear how the will may be determined, and whether there is a doubling or even tripling of substance: If voluntariness is determined by the use of a psychological tool, how is its usage to be determined? In an attempt at a non-contradictory solution of the problem of voluntariness, placing it in the most developed form of the cultural-historical approach, A.R. Luria had to resort to verbal gymnastics in the genre of dialectical materialism: "Rejection of the idealistic notion of higher mental functions as the manifestation of some spiritual principle detached from all other natural phenomena, as well as rejection of the naturalistic approach to it as natural properties inherent in the human brain, may be considered the main achievement of modern psychology" (Luria, 1969, p. 142). Later, in the absence of meaningful

discussion of the problem of voluntariness, this idea in neuropsychology transposes itself into the problem of cerebral localization of voluntary functions: "The mechanism of voluntary regulation of higher mental functions can be regarded as the substantive principle of cerebration whose violation causes a whole set of defects, or 'frontal lobe' neuropsychological syndrome. Observations and special investigations show that the voluntary speech regulation of higher mental functions is related predominantly to the functioning of the left frontal lobe" (Khomskaya, 2005, p. 223).

In Vygotsky's cultural-historical conception, voluntary control is achieved through internalization of externalized object-centered activity by means of its mediating sign. One of the notions here requiring clarification is the idea of internalization. Despite widespread usage of this term, its specific mechanism remains quite mysterious. Literally, internalization is a transposition inwards of that what has been outside, but it is impossible to compare it to something like swallowing or putting something external (what in particular?) into one's head, brain, or psyche (what?). Comparative analysis of the usage of this term shows a difference not only in the theoretical understanding of the phenomenon of internalization, but also in defining the range of the phenomena that relate to it. This fact makes us presume that the term "internalization" implies several different notions more or less linked to one another, and frequently combined uncritically (Senyushchenkov, 2009).

One can attempt to illustrate the mechanism of internalization by addressing the most elementary instance of internalization of an outward object. The phenomenon of the probe can be found in the works of A.N. Leontiev and N. Bohr, but was described for the first time by Aristotle under the name of "the blind man's stick". This phenomenon, which offers remarkably rich possibilities of interpretation, enables us to understand the simplest model of the basic laws of one of the most complicated psychological phenomena, that of internalization.

Its essence is the following: when a blind man feels a surface with his stick, and a surgeon uses a probe to find a bullet in a wound, an amazing thing occurs. Their sensations are not localized at the boundary between the hand and the probe (where they should be, because the probe is a foreign body, and the hand is part of my body. The probe exerts pressure on cutaneous receptors, that is, the sensation should be localized exactly at the probe's intersection with the body), but paradoxically, at the extremity of the probe. This is paradoxical, because it turns out that the distant receptor is encompassed by the configuration of the body, becoming its extension and, as a matter of fact, becoming internalized. This internalization continues until the probe shows its "rigidity", that is, the predictability of possible changes. As soon as another person sets it in motion, or it changes its form and/or degree of subordination in an unpredictable way, it inevitably becomes externalized, and the sensation shifts to the boundary between the hand and the probe.

The most important thing here is that the boundary of localization is directly determined by the limit of autonomy and predictability, its dependence on the subject — always provided that the probe does not change its form, remains constant, and all its actions can be predicted and taken into account. In other words, the internalization of the probe in this example is its embodiment in the body scheme. It does not mean that we put it inside ourselves, but that it turns into a person's instrument, a prosthesis by means of which actions are as predictable and subject to us as our biological body's actions. Furthermore, it follows from this example that the internalization-externalization ratio is not fixed, but may dynamically change

depending on the circumstances. Our own body is not inherently internalized; in some situations it is uncontrollable and unpredictable, which feels like *alienation* (intoxication, numbness, etc.). Similarly, complex forms of instrumental extensions are internalized; they cease to be conscious, losing the possibility to be taken into account and anticipated. In this situation, internalization is nothing other than the adoption of a scheme of relations with these complex forms of instrumental extensions, of models of behavior, whereupon these extensions cease to be reflected upon, to be a phenomenon of our consciousness, but instead become unconscious.

That does not mean that they cease to exist; if circumstances change, they may be externalized again. Thus, in the phenomenon of "a stalled escalator", which in no way differs from an ordinary stairway, a person suffers an intense sensation of motor discomfort. We have an internalized model of a moving escalator, and were prepared to adapt to its movement with a specific set of motor responses. Similar extensions include cognitive schemes, maps, measurements, grammar, etiquette, and so on. In this interpretation, internalization fits into specific meanings of this term: 1) transformation of outward, observed forms of activity into inner (unobserved) processes; 2) transformation of forms of joint (collective) activity into forms of individual activity; 3) a person's adoption of norms, mindsets, values, etc. of a group (Senyushenkov, 2009). This also eases the transition of a material, outward action into an ideal, inner one, for it is not the action that is internalized, but its scheme. In this sense, the historical-cultural approach is in no way restricted by mental functions, and it has wide prospects for development.

However, in our present understanding of the psychological essence of internalization, cultural-historical theory's classical statement — that higher mental function is the internalization of external activity that has become voluntary and conscious — has become controversial. In fact, genuinely internalized activity actually ceases to be conscious and voluntary, moving instead into the zone which, following N.F. Dobrynin (1938), can be called post-voluntariness. For Dobrynin, post-voluntariness is limited by the attention and is related to a loss of voluntary activity, and that becomes interesting. But this idea is much richer and it may turn out to be productive for the development of cultural-historical theory itself. If we assume that any function, after passing the stage of de-automation of its involuntary, natural realization through an unfolded, interpersonal stage, and later a conscious, reflexive, interpersonal stage, shifts to the post-voluntary level, which makes it possible to considerably simplify and optimize complex forms of activity.

Post-voluntary and involuntary functions in relation to awareness are only outwardly similar. Involuntary functions are *primarily* "transparent" (unconscious) for the subject; they may only become opaque when being acquired; they are subject to the logic of the mechanism and are described in the language of tropisms. "Transparency" (*post-voluntariness*) is *derivative*; the functions *have already become transparent* after being acquired, but their potential to become conscious is easily demonstrated in various complicated situations.

The discrepancy between the innate and "cultural" in a person creates a gap, in which there develop specific disorders related to functional and conversion symptoms. The principal chance for their realization is determined by the mobility of ego boundaries, which makes it possible to set up a specific configuration of "false boundaries", imitating organic pathology. Although this hypothesis needs special discussion and proof, one may assume that the mechanism of formation of conversion and

dissociative symptoms is that they display themselves only in "semi-transparent" functions that are acquired (or could be acquired in principle). Movement disorders such as astasia abasia, mutism, colitis, constipation, diarrhea, enuresis, dysphagia, emesis, dyspnea, aspiration, hysterical dumbness, aplasia, deafness, functional amnesia, pseudo dementia, etc., do not occur on the anatomical or physiological level, but on the functional level, as a disorder of control, a shift in the zone of control. Indirect confirmation of this hypothesis is that there are no conversion disturbances of the hematopoietic system, i.e., the work of the liver and kidneys. The core of conversion and dissociative pathology is the failure of control over these functions on the level of post-voluntary realization (or, conversely, the introduction of latent control over previously automated functions) and a shift of the subject's boundaries from an external to an internal contour when the action becomes directed not to the object, but to the function itself.

There is a very interesting and promising field of analysis of psychological and brain mechanisms in the mismatch of possibilities to realize a function on different levels: involuntary, voluntary, and post-voluntary. Vygotsky describes a case of voluntary compensation in Parkinson's disease. "A parkinsonian patient cannot take a step; but when you tell him: 'Take a step!' or lay a piece of paper on the floor, he takes that step. Everyone knows how well parkinsonian patients go up and down stairs and how badly they walk on an even floor. You have to lay a number of pieces of paper on the floor in order to lead the patient to the laboratory. He wants to go, but he can't affect his motility; this system is damaged in him. Why is it that a parkinsonian patient can walk when pieces of paper are laid on the floor?" (Vygotsky, 1982, pp. 129–130). The explanation given by Vygotsky — "The system that enables him to raise his hand is now damaged. But he can link one point in the brain with another by means of an external sign" (ibid.) — is not fully clear. What does the linkage "of one point in the brain with another" through an external sign mean in this case?

A more convincing interpretation of this phenomenon is given by Luria: "Compensation for movement disorders turns out to be possible by the rearrangement of the mental processes that he used when walking. The activity is transferred from the subcortical level, where the foci of the lesions are located, to the less damaged cerebral cortex" (Luria, 1982, p. 110). However, it seems to me that there is no way to contend that walking is an entirely involuntary, purely reflex action; at a minimum, it includes directional programming; but it is more of a post-voluntary function that involves purely reflex connections, and extends further. As M.M. Bakhtin noted: "The person directing his hand to an object, of course, doesn't voluntarily direct the muscle contractions necessary for the act of grasping, but part of the movement towards the object is quite voluntary" (Bakhtin, 1928). Likewise in Jackson's example of the patient who is asked by the doctor to say "no" and says, "No, doctor, I can't say no", we should recognize that the reflex basis of the action is fully preserved (otherwise, no such action could have been possible), but what is damaged is its inclusion in a voluntary or post-voluntary act.

The clinical picture of Gilles de la Tourette syndrome provides another demonstrative example of the discord among the involuntary, voluntary, and post-voluntary components. Luria wrote about this syndrome: "Any progress in explaining Tourette syndrome fundamentally broadens our understanding of human nature as a whole…. I don't know any other syndrome, the meaning of which is commensurable with this" (Sacks, 2006). Tourette syndrome is characterized by its manifold

obsessions, tics, echolalia (shouting obscene or sacrilegious words) in a particular situation where that is prohibited, for instance, in church. Though Tourette syndrome has a confirmed organic basis, its interest for psychology is connected with the actual moment of control: an involuntary verbal product is pointedly linked to efforts at its voluntary regulation, and through its content, to the culture. A patient with this syndrome does not simply cry out any words, but specifically those marked by the culture as forbidden.

There is one more parallel with functional conversion and dissociative disorders, which is intrusive/aggressive thoughts: when the patient has obsessive thoughts about involuntarily harming the very person he or she does not want to harm (for instance, the mother who is afraid of throwing her child out the window or stabbing the child). Although we have tried to describe the intricacies of these syndromes, showing the close connection of voluntariness, organic or functional foundations and the cultural context of the symptom formation, studying them from a psychological standpoint using the cultural-historical approach in clinical psychology seems very promising.

Situating the child in the cultural context is associated with objectification of his physical activity, physiological manifestations, and with the setting of limits. The subsequent overcoming and "enfolding" of these are also the way to socialization, the development of voluntariness, and the derived "transparency" of corporeal functions. The creation of "objects" in the path of the subject is a constantly flowing task of the new topology of the subject-object division. As to pathology, in this case it just confirms the existence of this already-concealed inner "support structure". Different cultures and historical epochs, which ascribe specific responsibility and blame to the subject, produce various configurations of the subject-object discontinuity and, accordingly, various types of concealed structures defining the pathomorphism of conversion disorders.

There is one more point that needs clarification: the content of the interpersonal phase of the formation of the higher (non-natural) function. In the classical version, it is a shared performance, which enables the child to master forms of behavior inaccessible to him on his own. The ontogenetic history of "higher" human functions is usually explained as the aggregate of rather "vegetative" events. A little child in cooperation with an adult (as a representative and bearer of culture) joyfully assimilates new forms and modes of activity, internalizing them (to be sure, it is not always clear how) and shifting to a new level of mental functioning. Nevertheless, theoretical speculation, clinical observations, and even everyday experience do not accord very much with such felicity. Even the acquisition of simple alimentary and hygienic habits does not run smoothly, and the phenomenon of punishment itself in the broadest sense, which is fundamentally ineradicable from culture, generally casts doubt on the idea of absolute harmony of the dyad adult-child or subject-society. Eating with one's hands is much simpler than with a fork; skating, playing the violin, and simply reading are not physiological; regulation of corporeal functions, drives, and needs requires constant and quite serious efforts. The acquisition of social and cultural norms differs little in principle from the mastery of the law of gravity through the practice of falling, and of the proper way to handle matches from a painful burn.

In current theoretical and practical research, it is extremely important to formulate and integrate a number of important concepts into the development of modern

psychology, concepts which correspond to the urgent challenges of the cultural-historical process, and, consequently, to the goals of psychological theory and practice. We need to clarify the very concepts of "violence", "effort", and (to be more precise) their interrelation. The implicit and incorrect assumption is that a function generated by cultural transformation possesses indubitable advantages over a natural one, and if we are faced with some of its imperfections, then it has been imperfectly acquired.

The advantage of higher functions over natural ones is not so obvious. V.M. Allakhverdov points out that the newborn child possesses such perfect reflex control (for instance, the grasping reflex allows the child to do chin-ups, after grabbing the hand that is lifting him) which he doesn't achieve on the voluntary level anytime soon, maybe never; and capabilities, speed, and volume of information processed on the conscious level never match the capabilities of the human organism (Allakhverdov, 2003). The advantages of higher functions lie elsewhere: in the possibility to go beyond existing stimulation, to act or not to act according to some other, non-natural rules, and sometimes despite them. Here we should especially underscore that *denial, inhibition, and prohibition,* as forms of socialized self-regulation, have no less significance than mastery of something jointly with an adult. Effort and tension are especially important for generating higher forms of the psyche. Further internalization has to involve an obligatory stage of externalization of involuntary natural activity, its objectification, and the subsequent post-voluntariness requires the preceding de-automation. Leontyev's well-known parallelogram of development reflects very important, but not fully intelligible phenomenon, that is, possible deterioration of activity at the initial stage of the acquisition of mediating instruments. The comprehension of "inhibition", "restriction" as the essence of the interpersonal stage of higher function formation is analyzed in some detail by D.B. Elkonin (1988), and earlier by Ribot (cited in Nicolas, 2008).

As mentioned above, the cultural-historical approach in its classical variant applies to quite a limited number of mental functions, although there have not been and there are not any fundamental limitations in this approach to understanding either mental or non-mental functions. It concerns primarily the cultural transformation of the human body, which is extended not only by the acquisition of instruments, but by the total transformation of the senses, motor capacities, and even formation of virtual mental functions (the Internet, computers, imaging systems) (McLuhan, 2011).

This is a new field for application of the cultural-historical approach to the transformation of culture itself and generation of fundamentally new psychological instruments/tools, which go beyond a simple sign or physical body. However, the foundation for such a transformation is already laid at the formation of the cultural body, the cultural bodily and physiological functions, which do not coincide with the way the natural functions at their foundation are realized and managed. In the most general form, the idea of a cultural body was formulated by K. Marx in his remark, "Hunger is hunger but the hunger gratified with cooked meat eaten by a knife and fork is a different hunger than that which bolts down raw meat with the help of hand, nail, and tooth" (Marx & Engels, 1955, p. 28).

The restrictions imposed on natural functions by society create a fundamentally new "landscape" of the cultural body. Prohibitions and rules that govern eating and excreting create the new reality of an "alimentary" body; rules of hygiene cre-

ate the subjective phenomenon of "cleanness and dirt"; sexual prohibitions cultivate the "erotic body". The last group of taboos is particularly demonstrative. Sexual impulses, colliding with the regulation of their manifestations, form totally unique ideas about the erotic/non-erotic, which are closely connected with the historical, religious, and ethnic variants of what is banned or allowed. Although sexual attraction is traditionally regarded as among major and most fundamental human needs, control over it can be traced to the dawn of human history, particularly in European culture. European culture is characterized by zones of "acceptable" manifestations of sexuality and the distinct "marking" of those that are forbidden. This requires mastering one's erotic attractions and turning one's sexual impulses from natural and involuntary into voluntarily regulated.

Following Vygotsky, if one accepts that the most important "trait of higher mental function is mastering one's own behavioral process", then it is perfectly logical that sexuality loses its involuntary character quite early. Moreover, this is the only human function whose canons of realization are even fixed by legislation. As a result, there is a new, socially determined regulatory principle of sexual conduct. It is sexuality that most corresponds to the idea of "cultural development", that "not nature but society should be regarded as the determining factor of human behavior".

The hierarchical structure of human sexuality shows itself in that the natural need for procreation is instinctive in nature, with clearly delineated unconditioned stimuli; it is realized as a chain of reflexes, under conditions that correspond to these unconditioned stimuli. It also shows itself in that from a certain point it begins to conform to conventions that are not biological, but social in nature, and it becomes a "genetically more complex and higher form of behavior". The hierarchical structure of human sexuality reveals itself in its potential for repeated breakdown: for instance, "removing" higher regulatory forms when a person is under alcoholic or drug intoxication, in a pathological state of affect, in frontal lobe syndrome and other lesions of the cerebral cortex. As in some other variants of higher mental functions, in the new structures of human sexuality (unlike lower mental functions) the difference lies in, first of all, that the direct unity of stimuli and reactions in a single complex is broken.

Exactly like other mental functions, human sexuality is characterized by the lifetime social nature of its formation. However, in this case the specific socialization is determined by the combination of the severity of prohibition, its inner contradiction and not always explicit wording, and that the interpersonal stage of its formation is mostly characterized by the sharing not of the *fulfilment* of the function, but its *prohibition*. What is mastered at the start is not only and not so much the model of realization, but also the stereotype of inhibition. M. Foucault demonstrates that the silent management of children's sexuality by interpersonal activity may be realized not only in words, but also in the very architecture of educational buildings (Foucault, 1996).

Last but not least, let us dwell on one of the most remarkable moments of the socialization and transformation of innate biological functions into higher mental functions, regulated voluntarily and then post-voluntarily and mediated by special tools. Besides the generation of new forms of activity, this process may be attended by a somewhat incidental but still fundamental feature: the generation of the subject itself, consciousness. Having encountered an obstacle on the path of the involuntary, unconscious fulfillment of any natural function, the subject "clarifies" itself for itself,

becoming the object for itself. This is possible only under conditions of "delayed", "restrained" activity, whereby the subject displays itself in the form of a subject of deficiency, and then also of activity.

The clarification occurs, apparently, according to a universal mechanism of consciousness: one becomes aware of everything that meets with an obstacle on the path of direct and unfettered realization. We confront the substance of thinking when we cannot accomplish a task, and the substance of memory when it fails us. This resembles the probe, which phenomenologically exists in the zone of its "semi-transparency", partial controllability. As soon as it ceases to obey fully, it turns into an external object; and as soon as it becomes fully subordinate and predictable, it becomes part of the body scheme and is no longer conscious. It can be represented as a metaphor of glass: if we see completely opaque glass, we have no way to determine its thickness, it appears to us only as a surface; if it is utterly transparent, we cannot perceive it at all. The glass appears to us only when we encounter it one way or another, if it is semi-transparent or dusty.

The genesis of "subjectness", like all the forms of higher activity, takes place in ontogeny, when the child encounters cultural restrictions and requirements and has to accommodate himself to them, turning himself, in a process of "normal alienation" from equivalent physical and physiological "forces", into the author of his actions. Another precise ontogenetic instance of generating subjective responsibility: making the child sit in the corner. This situation is differentiated from normal action. The child's actions are not confined with the physical limits of the situation: he can leave the corner but does not do so, transforming the lack of action into his own action, another person's will or the fear of punishment into his action of "inaction".

This is the stage of ontogenesis when the child is forming his own consciousness. J. Piaget's statement about the connection of the advent of egocentric speech with the difficulties of the operational aspect of the child's activity can be amplified with a hypothesis about the necessity of normal self-alienation, the primary externalization of the ego with a subsequent new internalization and the formation of a mature identity. In other words, an adequate identification is the product of the internalization of what was previously externalized; it develops in a process of stepwise formation of the ability for voluntary regulation. This is the stage of egocentric speech when the child speaks of himself in the third person, which is corroborated by the relatively late formation of the first person pronoun in language and with the absence of phenomena of alienation in younger children and in archaic cultures.

Conclusion

The cultural-historical approach to the problem of socialization may be considered in a much broader way than as merely the development of higher mental functions. It is about the transformation of biological substance into human substance. Through this process a person becomes not only the slave of his environment, perceptive field, or instinctive drives and emotions, but he gains a set of psychological tools to separate himself from these and acquire a certain autonomy.

Some of these technologies are quite obvious. For instance, there are entire technologies to stimulate the appetite or arouse sexuality, such as culinary arts and pornography. But other mediating instruments are less evident and use both chemical and non-chemical mediators: drugs, alcohol, medicines, as well as poetry, music,

and philosophy. But all of these are the tools of human culture, helping people master their own behavior. The socialization of natural properties, psychic, physiological, corporeal functions, drives, and needs is remarkable for all aspects of human existence, from the birth of a child until his death including, a culture's most existential moments: life and death, conception and birth, sickness and health. These are not simple landmarks and properties of biological existence, but to a great extent socially and technologically mediated phenomena.

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