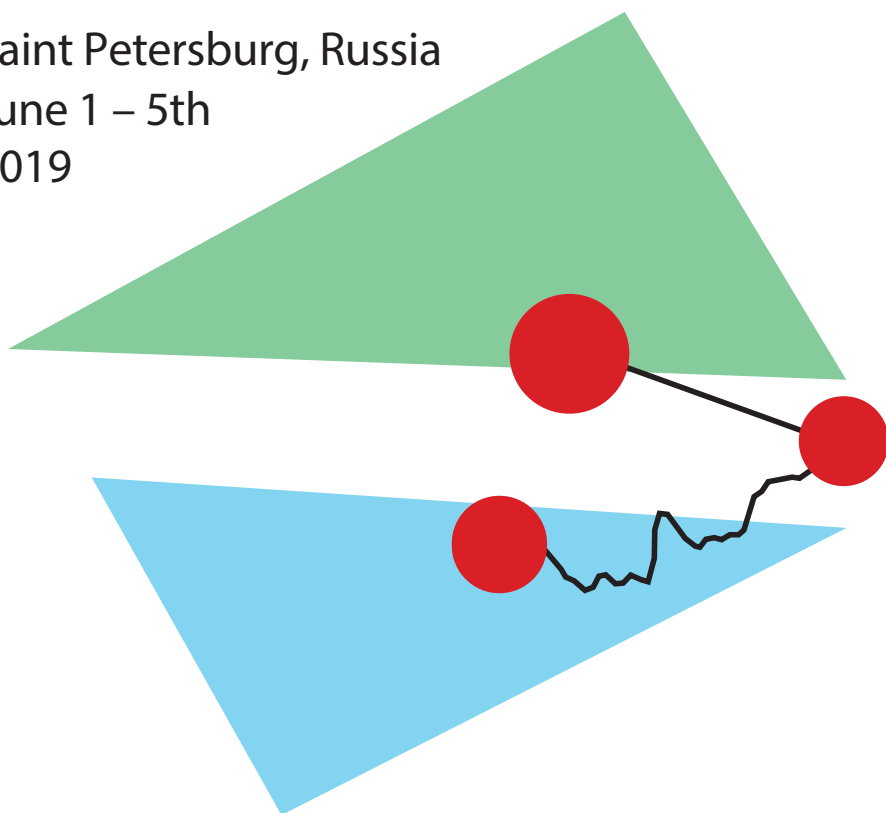*Proceedings of the 3nd International Conference*

NEUROBIOLOGY OF SPEECH AND LANGUAGE

Saint Petersburg, Russia
June 1 – 5th
2019

Organised by the Laboratory of
Behavioural Neurodynamics,
Saint Petersburg State University

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Neurobiology of Speech and Language

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Edited by Olga Shcherbakova

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POSTER SESSION 2

OPEN LECTURES

Irene Pepperberg

Harvard University, Cambridge, USA

Cognitive and Communicative Abilities of Grey Parrots

I have studied the cognitive and communicative abilities of Grey parrots (*Psittacus erithacus*) for over forty years. My students and I train parrots to use elements of English speech, then use this capacity for symbolic representation to test their intelligence. The paradigm allowed us to test one bird, Griffin, on the classic Piagetian probability task (three items of one type and one of another are hidden in a bucket, one item is surreptitiously removed; the subject is asked to label that object). Griffin correctly matched probabilities by appropriately vocally producing the most likely (though not necessarily the correct) answer; he scored at a level comparable to ~7 year-old children and outperformed apes. Even when symbolic representation is not explicitly required for a task, it may be crucial for success. In a study of visual working memory manipulation (a more complicated variation of the "shell game"), Griffin outperformed even 8-year old children and was close to the level of adult humans; we suspect he used mental symbolic rehearsal in order to succeed.

Michael C. Corballis

University of Auckland, Auckland, New Zealand

How Language Evolved: A Darwinian Perspective

From the Bible to Chomsky, language has long been considered unique to humans, emerging in a single step, even in a single individual, in defiance of Darwinian principles. I argue that language emerged primarily as a means to communicate about events removed from the present (the property of *displacement*), which in turn is based on a capacity for mental time travel, also widely regarded as uniquely human. Recent evidence suggests, to the contrary, that mental time travel has a long evolutionary

history, and is demonstrable in many species, including birds, mammals, and perhaps even insects and cephalopods. The capacity to communicate mental time travels arose much later in social animals, emerging from intentional bodily action rather than from vocal calls. It reached a high level of sophistication in humans, probably in a gradual progression from gestural communication in apes, through to pantomime in early hominins, and becoming increasingly grammaticalized, conventionalized, and (in most individuals) vocalized in the genus *Homo*. The progression from mental time travel to modern human language can be understood in terms of Darwinian evolution, and need not imply any sudden, miraculous origin.

Luciano Fadiga

University of Ferrara and Italian Institute of Technology, Italy

Sensorimotor Grounding of Speech and Language from a Neurophysiological Perspective

What is language? The answer to this question largely depends on the background of the person asked to respond it. Depending upon one is a linguist, a neurologist, a psychologist, the answer will be completely different. This is the reason of the huge difficulty in creating a multidisciplinary approach to this issue. In recent years, neurophysiologists, traditionally far from this kind of "holistic" questions, have obtained some empirical evidence that sensorimotor circuits could be at the basis of specific properties of the human language. Among them, syntactic processing and interpersonal communication mechanisms. Critical to this approach is the study of how the brain represents actions, own's and others', and how communication occurs.

In my talk I will focus the attention on the possible analogies between language and action domains, showing that more than looking for similarities between motor planning and linguistic structures, similarities should be sought in the hierarchical structure that characterizes the structural (neural) organization of the motor system. Therefore, no

planning (software) but computational potentialities of a sensorimotor structure (hardware) that has undergone a developmental soaring because of the evolution of new capacities. Particularly interesting in this regard is the role played by Broca's region, traditionally considered as the frontal center for speech production, but more and more considered as a venue for common syntactic processing in both action and language domains.

KEYNOTE LECTURES

Nuria Sebastian-Galles

Pompeu Fabra University, Barcelona, Spain

The onset of bilingualism: Specificities in the first year of life

How different is the process of language learning in infants exposed to two languages from birth? It was not so long ago when the available evidence pointed to a delay in language learning in bilinguals. At present, a bulk of studies indicates the existence of specific adaptations to the process of language learning. In the present talk I will focus on the emergence of such adaptations during the first months of life.

Lorraine K. Tyler

University of Cambridge, Cambridge, UK

Language dynamics: Combining language modelling and MEG imaging to understand the incremental interpretation of spoken language

Understanding spoken language involves a complex set of processes that transform the auditory input into a meaningful interpretation. Our percept is not of acoustic-phonetic detail but of the speaker's intended meaning. This transition occurs on millisecond timescales, with remarkable speed and accuracy, and with no awareness of the complex computations on which it depends. How is this achieved? What are the processes and representations that support the transition from sound to meaning, and what are the neurobiological systems in which they are instantiated? Surprisingly little is known about the specific spatio-temporal patterning and the specific neuro-computational properties of this complex dynamic system.

In current research we address these issues by combining advanced techniques from neuroimaging, multivariate statistics and computational linguistics to probe the dynamic patterns of neural activity that are elicited

by spoken words as they are heard, and the incremental processes that combine them into syntactically and semantically coherent sentences. Computational linguistic analyses of language corpora enable us to build quantifiable models of different dimensions of language interpretation — from phonetics and phonology to argument structure and semantic integration — and we test for their presence using multivariate methods on combined electro- and magneto-encephalography (EMEG) data, as the utterance unfolds in real time. In this talk, I will present the novel account of speech comprehension that is emerging from this research.

William D. Marslen-Wilson

University of Cambridge, Cambridge, UK

The evolution of language as a neurobiological system

Evidence from neuroimaging, neuropsychological and behavioral studies points to a Dual Neurobiological Systems approach to human language and communication. Potentially human-specific capacities in the domain of combinatorial morphosyntax are primarily supported by a left-hemisphere frontal-temporal system. These operate in conjunction with a bihemispheric system largely based on capacities for conspecific communication that we hold in common with our nonhuman primate relatives. Placing these hypotheses in their palaeoanthropological context, and adopting a gradualist, multi-factorial approach to the emergence of language in the modern human, the talk will examine emerging evidence for a range of language- and communication-relevant neurobiological capacities in our primate relatives (and the inferred Last Common Ancestor). These may shed light on the neurocomputational capacities underlying the role of the left-hemisphere subsystem, and reveal the surprising degree of structural and functional commonality between the human and nonhuman primate systems that support conspecific communication in the complex social contexts typical of most primate species. Aspects of 'biolinguistic' hypotheses about language evolution will be evaluated as appropriate.

Sonja A. Kotz

Maastricht University, Maastricht, The Netherlands

Cerebellar contributions to speech processing

While the role of forward models constituting cross-communication between cortical and subcortical areas is well established in the motor domain, there is recent evidence that sensory encoding of time in basic and more complex auditory stimuli (e.g. sound and speech) similarly engages cortico-subcortico-cortical circuitry (Kotz, Schwartze, 2010; Schwartze, Kotz, 2013). For example, animal studies indicate that *crossed* cortico-cerebellar pathways, originating in superior posterior temporal regions, project towards paravermal cerebellar areas (e.g. Schmahmann et al., 1991). However, only a few studies have considered posterior temporo-cerebellar effective connectivity in humans (e.g. Pastor et al., 2006, 2008). Considering the functional relevance of a temporo-cerebellar-thalamo-cortical circuitry that aligns with well-known cerebellar-thalamo-cortical connectivity patterns in the motor domain (e.g. Ramnani, 2006), one may consider that cerebellar computations apply similarly to temporally coded basic and complex auditory information as (i) they simulate cortical information processing, and (ii) cerebellar-thalamic output may provide a possible source for internally generated cortical activity that predicts the outcome of cortical information processing in cortical target areas that (iii) possibly provide a temporal frame for cortical temporal information processing (Knolle et al., 2013; Kotz et al., 2015). I will discuss our current conceptual thinking (Kotz, Schwartze, 2016; Schwartze, Kotz, 2016) as well as new empirical data in support of these considerations and present an extended cortico-subcortical network involved in the temporal processing of basic and complex auditory information such as speech.

Zhanna Reznikova

Institute of Systematics and Ecology of Animals, Siberian Branch RAS, Novosibirsk, Russia

Language for numbers and numbers without language

Until recently, it was widely believed that the main difficulty in comparing numerical abilities in humans and other species is that number-related skills in our species are closely connected with our capacity for language and symbolic representation. However, not all human cultures possess linguistic means for number representation. Besides, recent studies that combine behavioural and neurobiological methods have changed our picture of numerical reasoning in animals.

An important idea emerging from this research is that adult humans share with non-human animals a system for representing numbers as language-independent mental magnitudes, and that this system emerges early in development.

The fundamental nature and the adaptive value of basic number-related skills in animals have been thoroughly documented. The club of 'numerically competent' animals already includes many species, from insects, spiders, salamanders, lizards and fishes to birds, rodents, dogs, cats, horses, dolphins, elephants and primates, and continues to accept species whose numerical abilities have been underestimated before. For example, in our experiments (Reznikova et al., Animal Cognition, 2019, 22) striped field mice exhibited high accuracy in discriminating between large quantities that differ only by one, such as 8 and 9, which has only been demonstrated in primates before.

Animal abilities to judge about proportions and numbers of things and events, sounds, time intervals, and smells have been considered a reliable tool for studying intelligence. A balance between the core system of numerical competence and the ability to flexibly solve new problems basing on number-related skills remains enigmatic. Possibly the reason is that most of the existing experimental schemes for studying numerical processing in animals, although often elegant, are restricted by studying subjects at the individual level, or by the use of artificial communicative systems. In contrast, the information-theoretic approach that was elaborated for

studying number-related skills in ants employs their own "language" and, thus, does not require the subjects to solve any artificial learning problems, such as learning intermediary languages, or even learning to solve multiple choice problems. Using this approach, it was discovered that members of highly social ant species possessed numerical competence (Reznikova, Ryabko, 1994, 2011; Reznikova, 2017). They were shown to be able to pass information about numbers and to perform simple arithmetic operations with small numbers. We suggest that applying ideas of information theory and using the natural communication systems of highly social animals can open new horizons in studying numerical cognition.

SLIDE SESSION 1

Svetlana Malyutina[1], *Elena Savinova*[1], *Zoya Evdaeva*[1],
Anna Laurinavichyute[1], *Galina Ryazanskaya*[1], *Alexandra Simdyanova*[1],
Anastasiya Antonova[1], *Anastasiya Lopukhina*[1]

[1] National Research University Higher School of Economics

The effects of aging and visual noise on good-enough sentence processing

According to the good-enough model of language comprehension (Ferreira et al., 2002), we do not always perform full algorithmic analysis of linguistic input. Rather, we often form shallow and underspecified representations based on lexico-semantic heuristics. But little work has studied what factors may trigger or increase the reliance on good-enough processing. In the current study, we tested whether it would be increased by two factors: one endogenous (older age of the comprehender) and one exogenous (noisy processing conditions).

To date, 61 younger (18–39 y.o.) and 36 older (55–91 y.o.) participants took part in the study. The task was self-paced (word-by-word) sentence reading with comprehension questions. In the noise condition, stimuli were accompanied by visual noise (short idioms presented for 300–400 ms in random positions on the screen); in the no-noise condition, they were presented on a blank background. The stimuli were Russian grammatically complex sentences with a genitive noun phrase and a participial clause syntactically attached either to the semantically plausible (1, 2) or to the semantically implausible noun (3, 4). Lower comprehension accuracy for semantically implausible than plausible sentences should indicate increased reliance on good-enough processing.

(1) Rimma dressed the child (Acc, fem) of the writer (Gen, fem) who was babbling (Acc, fem) incomprehensible words. [The child was babbling — Plausible]

(2) Rimma dressed the child (Acc, fem) of the writer (Gen, fem) who published (Gen, fem) an interesting novel. [The writer published a novel — Plausible]

(3) Rimma dressed the child (Acc, fem) of the writer (Gen, fem) who published (Acc, fem) an interesting novel. [The child published a novel — Implausible]

(4) Rimma dressed the child (Acc, fem) of the writer (Gen, fem) who was babbling (Gen, fem) incomprehensible words. [The writer was babbling — Implausible]

We found that older participants, indeed, showed greater reliance on good-enough processing (Plausibility x Age: p = .003). This is consistent with previous studies showing an increased role of context-based prediction in older comprehenders. However, reliance on good-enough processing was not increased by more challenging processing conditions, that is, by visual noise (Plausibility x Noise: p = .94). This null result can be due to insufficient noise levels and should be replicated in more challenging processing conditions.

Tatiana Logvinenko[1], *Oksana Talantseva*[1], *Irina Ovchinnikova*[1]

[1] Saint Petersburg State University

Lexical access on early stages of visual perception: Evidence from Russian

The role of N170 ERP component in processing of lexical and sublexical characteristics of visual stimuli is controversial. N170 was demonstrated to reflect perceptual expertise at the prelexical level, and recent evidence suggests the early access of N170 to lexical and sublexical properties, as seen from the different N170 response to words, pseudowords and nonwords (e.g., Sereno et al., 1998; Hauk et al., 2006; Araujo et al., 2015). However, some studies report similar brain response to these stimuli, marking high dependency of N170 to the transparency of the orthographic system (Maurer et al., 2005). The current study was aimed to investigate the brain responses to a set of Russian words and word-like stimuli calling for different amounts of lexical orthographic processing.

Total number of 34 Russian native-speakers (17 females; age range: 16–29 years, M = 20.5, SD = 3.8; non-verbal IQ ≥ 85) participated in an ERP study while implicit reading. EEG was recorded at scalp using actiChamp system with 64 Ag/AgCl electrodes. The experimental stimuli included (40 trials each): high-frequency (HF; лошадь/loshad'/ — horse) and low-frequency

words, pseudohomophones (PH; тварок/tvarok/ — творог/cottage cheese), pseudowords (PW; мисуфи/misufi) and false fonts. The responses only to HF, PW, and PH were analyzed. Each trial was followed by two letters/symbols, and participants had to answer which one was in the stimulus.

Repeated-measures ANOVA indices were computed on the peak latencies and amplitudes of the N170 separately in the left and right parietal electrode clusters. There was a main effect of Condition on the N170 latency in the left hemisphere, $F(2; 66) = 4.18$, $p = .019$. Further independent tests revealed a significant increase in the N170 latency in response to PH and PW conditions in comparison with HF ($B = 10.58$, $SE = 4.11$, $t(66) = 2.57$, $p = .027$ and $B = 10.00$, $SE = 4.11$, $t(66) = 2.43$, $p = .039$, respectively) in the left parietal cluster. No differences were found between PH and PW conditions ($p > .05$). The revealed delay of the N170 component (~10 ms) in response to unfamiliar word-forms suggests the early left-hemispheric sensitivity to lexical characteristics of stimuli even in case of orthography with high spelling-to-sound correspondence. The results may be used in further investigations of individual and group differences in perceptual expertise and word decoding efficiency.

Beatriz Bermúdez-Margaretto[1], *Yury Shtyrov*[1,2,5], *Fernando Cuetos*[3], *Alberto Domínguez*[4]

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[2] Aarhus University
[3] University of Oviedo
[4] University of La Laguna
[5] Saint Petersburg State University

Ultra-rapid acquisition of novel written word-forms: ERP evidence

Fast acquisition of new words is a unique human skill, essential for ensuring a flexible and efficient communication system. It is believed to be a rapid process; at least in spoken language, learners are able to construct

memory traces for new linguistic stimuli after just few exposures, as reflected in online dynamics of electrophysiological activity in response to new words (Shtyrov et al., 2010; Shtyrov, 2011; Yue et al., 2014; Kimppa et al., 2015; Kimppa et al., 2016). However, such rapid word learning and its neural correlates have not been systematically found in visual domain, with some studies arguing that longer exposures and semantic associations are needed to acquire new lexical representations (McLaughlin et al., 2004; Stein et al., 2006; Breitenstein et al., 2007; Bakker et al., 2015).

To address this question, the current study explored the changes in the human brain activity occurring online, during a brief and meaningless training with novel written word-forms. The EEG signals from twenty-six participants were recorded during a silent reading task in which a set of 24 novel written word-forms were briefly trained without any semantic associations across six different presentations. A set of 24 familiar words was also included as a control condition for comparison. Cluster-based random permutation method was implemented for testing the effect of orthographic training, contrasting the brain's electrical activity elicited by novel word-forms before and after the training, across the entire ERP segment. Differences were also submitted to a finer-grain trial-by-trial approach across the six presentations, in order to better scrutinize the impact of each exposure.

Results revealed that training caused an extremely fast (after just one or two exposures) and stable facilitation in novel word processing, reflected in the increase positivity of ERP responses starting from ~140 ms after the stimulus onset. In particular, the activity of P200 and N400 components was found modulated by the training, possibly indicating rapid dynamics at both early and late stages of lexical processing of visual word-forms. Furthermore, additional comparisons revealed that P200 and N400 responses exhibited by novel and familiar words became similar by the end of the training.

Overall, these results indicate the formation of neural memory traces for novel written word-forms after a minimal exposure to them even in the absence of a semantic reference. Combined with previous findings in spoken language, current results suggest a cross-modal neural mechanism for building up new linguistic representations which enables efficient communication and reading skills.

Alyona Ivanova[1,2], Viktoria Obraztsova[2,3], Ekaterina Grabovaya[4],
Russell W. Chan[5], Olga Shcherbakova[6]

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Verbal humor comprehension in healthy people and psychiatric patients

Humor comprehension is an important cognitive and linguistic skill. It plays a crucial role in social well-being and is known to be affected by psychiatric diseases. The study presents a qualitative and quantitative analyses of verbal humor comprehension in healthy people (N = 39) and patients with schizophrenia and schizotypal disorders (N = 19) and affective disorders (N = 12) in comparison.

A set of 7 verbal jokes was administered to the participants individually and was followed by in-depth semi-structured interview that aimed to reveal the levels of cognitive (CHC) and affective humor comprehension (AHC) of each joke. All the interviews were audio-recorded and then transcribed verbatim; the protocols were assessed independently by 4 experts, who scored the interpretation of each joke in according with 5 levels of cognitive and 3 levels of affective comprehension (Shcherbakova, 2009). Expert scores' consistency was satisfactory (W = 0,547 for healthy people; W = 0,569 for patients, p = 0,000).

The results showed higher levels of humor comprehension in healthy people compared to those of psychiatric patients. The distribution of scores in the group of healthy people revealed that low levels of CHC (1 and 2) yielded 0 — 11,5% and high levels of CHC (4 and 5) — 20,5 — 59%. In psychiatric patients, the ranges were 3,2 — 38,7% and 6,4 — 32,3%, respectively.

Humor comprehension in psychiatric patients differed from those in the controls not only quantitatively, but also qualitatively. The jokes which appeared to be easy or difficult for understanding, differed between the

two groups. In patients, the correlation between cognitive and affective components was lower (r = 0,573, p < 0,001), than in healthy people (r = 0,696, p < 0,001) which led to their mutual decompensation and relative disintegration of the complex process of humor comprehension.

Patients with schizophrenia, compared to those with affective disorders, demonstrated humor comprehension disorders of a greater extent. Nonetheless, both components of humor comprehension — cognitive and affective — were impaired in both groups of patients, which is consistent with the idea of indissoluble functioning of intelligence and emotions.

A promising direction for future research is to conduct comparative studies of nosological specifics of humor comprehension disorders in schizophrenia and affective disorders.

Anna Smirnova[1], Maria Samuleeva[1], Zoya Zorina[1]

[1] Lomonosov Moscow State University

Hooded crows can learn signs to mark concepts

Study of symbolization or sign-referent equivalence in animals contributes to research of biological background of the human language. Proper equivalence exhibits characteristics of symmetry, reflexivity and transitivity. We have demonstrated that hooded crows can use transitivity to determine equivalence of numerical symbols from 1 to 8 and corresponded numbers and use numerical symbols after being trained generalized identity matching-to-sample.

In order to examine the property of symmetry in the next three experiments, we taught hooded crows arbitrary matching-to-sample task with letters «S» and «V» as samples and images of same-sized and different-sized figures as comparisons. In all three experiments, crows were taught arbitrary matching-to-sample with basic set of stimuli and then could perform the task with new stimuli (same-sized and different-sized figures on one stage and same-shape and different-shape figures on another stage of experiment).

These results argued that crows matched concepts of "similarities" and "differences" as referents of signs «S» and «V». The first experiment was conducted with crow which was previously taught generalized identity matching-to-sample. This bird successfully passed symmetry test, in which samples and comparisons were shifted around. This result may be due to previous experience (while performing generalized identity matching-to-sample, the bird was demonstrated sing-reference symmetry and reflexivity) or type of the referent (not certain stimuli but concepts). Subjects of the next two experiments were experimentally naïve crows.

In the second experiment, birds failed 1st symmetry test after being taught arbitrary matching-to-sample with two comparisons. But one of the two crows passed 2nd symmetry test after being taught arbitrary matching-to-sample with another ten comparisons. At last, both crows passed 3rd symmetry test after tests with new stimuli described above. This result, probably, may be due to the kind of referent (not certain stimuli but concepts), but it also may be influenced by the experience birds had during first two symmetry tests. For this reason, in the third experiment the only symmetry test was conducted after finishing training and tests with new stimuli. The crow passed the symmetry test, which indicates that kind of referent (concepts) plays a critical role in proper sign-referent equivalence.

Elizaveta I. Galperina[1,2], *Natalia V. Shemyakina*[1,2],
Zhanna V. Nagornova[1,2], *Olga V. Kruchinina*[1,2], *Alexandr N. Kornev*[2]

[1] Sechenov Institute of Evolutionary Physiology and Biochemistry RAS
[2] Saint Petersburg State Pediatric Medical University

Sentence processing in dyslexics and typically developed 9–14 years old children

Dyslexia is characterized by issues with reading despite normal intelligence. The main aspect of studies of dyslexia is decoding problem.

Neural mechanisms of comprehension of written texts on sentence level are poorly understood in dyslexics. By the end of primary school, children have to master main reading skills; during the secondary school, reading acquisition process is concentrated on whole text comprehension processes. The neural bases of comprehension in young dyslexics (9–14 y.o.) were the central point of our study.

EEGs of thirteen dyslexic children (Dys) (9–14 y.o.) and thirteen age and sex matching typically developing (TD) children (all native Russian speakers) were registered while they were reading and categorizing semantically correct /violated sentences presented in two steps — i) the contextual part of a sentence (i.e. "Dad entered…") and ii) the key word presentation ("…the room/the wall"). ERP's from 19 sites related to beginning of the sentence and the key word were compared i) within each group of children in two tasks and ii) between groups in same conditions (task).

The comparison of the ERPs related to the first parts of the sentences revealed higher amplitude in Dys compared to TD children in left frontal (F3) and right parietal (P4) cortical zones with 550-700 ms latency in semantically violated but not semantically correct sentences. Last word presentation elicited ERP's with higher amplitude in Dys compared to TD children in central zones in both conditions: correct and semantically violated sentences. N400 component amplitude was higher in Dys compared to TD children in: Fz, Pz during correct sentences presentation and in Cz, Pz — during semantically violated sentences presentation. Last positive components' differences were obtained in Pz, F4, F8 in correct sentences and only Fz — in violated sentences also with higher amplitude in Dys.

Late cognitive components (N400, P600) of higher amplitude in Dys in comparison to TD could reflect more effortful processing of written text even on sentence level. It could be explained by the development of the more specialized brain networks that enable the parallel mode of the text processing in TD children and lack of specialization or higher energy cost of low order reading processes in Dys. Differences obtained during violated but not correct sentences comprehension could be attributed to non-automatized, costly processing in Dys in complex or non-standard situation.

Evgenii Y. Shelepin[1], Kseniia A. Skuratova[2]

[1] Pavlov Institute of Physiology RAS
[2] Saint Petersburg State University

Dyslexia assessment model using the eye-tracker technique

Dyslexia is a reading disorder, associated with a phonological deficit that negatively affects the ability to perceive and process written language, which results in decreased reading speed and reading comprehension quality. The complexity of visual and phonological processing has a direct impact on eye movements during reading. Although atypical oculomotor patterns in reading are only a secondary consequence of dyslexia, analysis of oculomotor activity can be an effective way to assess the complexity of textual processing and a base method for developing automated diagnostic models of reading skills.

The sample consisted of 95 second-grade pupils from general education schools in the city of St. Petersburg: 55 students without a reading disorder, 18 students with a violation of the formation of reading skills due to a general underdevelopment of speech, 22 students with dyslexia. The task for the subjects was to read aloud the text of 55 words and answer the test to assess understanding of the text meaning. During the reading, eye movements were recorded using EyeTech VT3 mini eyetracker and MangoldVision stimuli presentation software.

The study showed that children with impaired reading skills, compared with the control group, performed a greater number of fixations, fixation durations were longer, as well as saccades of smaller amplitude and more regressions (higher percentage of regressive saccades compared to progressive). Based on the data obtained using discriminant analysis and classification trees, two diagnostic models were developed, including: the number of fixations per word (only for the discriminant model), the average duration of fixations, the average amplitude of saccades and the percentage of regressive saccades. Evaluation of the effectiveness showed the advantages of the classification tree method (C & RT) compared with the discriminant model: the sensitivity of the model was 94.83%, the specificity of 100%, the predictability of general speech impairment 98.70%, the predictability of dyslexia 100%.

This screening technique may be useful for obtaining a more detailed cognitive profile of the child, based on which the intervention strategies will be adapted to the individual characteristics and needs of students. Advantages of this method are fast processing time and objective result. It could be also used as a method of assessing the results of learning to read.

Vladislav Zubov[1], Tatiana Petrova[1]

[1] Saint Petersburg State University

Processing of adapted texts by Russian-speaking secondary schoolchildren with general speech underdevelopment

Handling the reading skills of the children with language disorders is one the main problems of correctional pedagogy (Bezrukih, 2000; Rusetskaya, 2009). Studies of dyslexia — a disorder characterized by troubled reading despite normal intelligence — are of high priority. Existing studies are mainly focused on investigating the reading process in primary school children, while adults and secondary school students are often left outside the research interest (Kornev, 2003; Akhutina, 2006; Inshakova, 2008). Moreover, there is no experimental evidence for different text types processing in children with language-related problems.

This study is one of the first eye-tracking experiments on Russian language material. It explores how children read and comprehend texts with various types of adaptation, namely one and the same text in lexical adaptation (replacement of complex and rare words to more common ones), and grammatical adaptation (simplified complex syntactic structures and sentences). To examine this issue, 32 Russian secondary school students from the correctional school № 3 (Saint Petersburg, Russia) were involved in the experiment. In a preliminary study, their reading skills were checked (Kornev, Ishimova, 2010), the subjective opinions of their teachers and speech therapists were collected and, as a result, the participants were divided into two groups: "good readers" and "poor readers". In the main

experiment, the students' eye movements were measured by Eyelink 1000+ during reading of 2 stimuli: a lexically adapted text and a grammatically adapted text on two different stories. Both versions of each text were equalized by the level of complexity via the http://readability.io/ resource.

The text comprehension and accessibility were controlled by the questions regarding the text and scaling method. The participants had to evaluate the level of difficulty while reading. The outcome has shown that there is no significant difference in processing (i.e. the total dwell time, the total fixation count, average saccade amplitude, average duration of the first pass and the number of regressions) and comprehension of lexically adapted and grammatically adapted texts: both types of adaptation proved to be efficient for recalling the information for both good and poor readers. We can conclude that the processing of lexis and grammar goes in parallel ways, none of them are "decisive".

SLIDE SESSION 2

Julia Zaitseva[1], Sergey Kopylov[1]

[1] Saint Petersburg State University

Does the ToM promote memorizing other's stories from author's point of view?

Theory of mind phenomenon (ability to understand mental states of others) is crucial for communication. Basic social-cognitive schemas of narration include protagonist's mental states as a part of intrigue. Narrator's perspective and mental states are represented in narrative structure itself (proactive/defensive type, optimistic/pessimistic tone, agency/communion theme, and redemption/corruption consequence). To recognize narrator's position, a listener ("storycatcher") has to reconstruct those narrative structures. It was empirically proved that improving narrative competence in storytelling practices supports theory of mind (ToM) construction in childhood (Guajardo, Watson, 2002; Miller, 2012). Is the reciprocal effect true? Does our ToM promote understanding, coding and memorizing stories from author's point of view?

We verified whether emerging adults (N = 39; age: 18–46, M = 25,9, s = 8,3) with higher performance in Theory of Mind test («Reading the mind in the eyes» RMIE scores, Baron-Cohen et al., 2001) could better differentiate narrator's position and keep it in mind along with the story plot. To make experimental procedure ecological, we chose as a stimuli 8 real personal autobiographical memories (self-defining stories), collected in narrative interview with 6 young adults. Stories varied in type, tone, theme and narrative consequence. Participants listened to those stories to memorize them. In a week, we asked the participants to retell the stories they have heard as close to original as possible, then to recognize the original stories choosing between two different narrative structures versions. Likewise, they took RMIE and wrote 3 own autobiographical self-narratives to actualize their narrative schema.

Qualitative analyze did not show significant differences in memorizing between groups of high and average ToM performance. Qualitative analysis showed stronger reinterpretations of narrative structure in personal stories retold in cases of lower identification with narrator, greater differences between narrator's and listener's narrative positions or identities. ToM

worked as a subtle mediating factor of emotional identity. Story-catchers showed tendencies for emotional identification with strong or winning protagonist and reinterpretations of loser's stories. We seem to be able to understand narrator's position precisely but still reinterpret it while memorizing and retelling according to our own narrative identity schemas. Results are discussed in the frame of Dialogical Self (Hermans, Hermans-Jansen, 1995) theory.

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Wernicke's area tDCS facilitates acquisition of novel concrete and abstract semantics

Existing evidence suggests that tDCS over Wernicke's area can positively affect semantic processing in speech disorders (e.g. aphasia) as well as in healthy participants. However, it is still unclear whether tDCS of this core language area can similarly influence the process of acquisition of novel semantics. To test this suggestion, we applied 15 minutes anodal, cathodal or sham tDCS over this area before a session of contextual learning of novel concrete and abstract concepts. Learning outcomes were assessed immediately after the training and on the next day to reveal any consolidation effects of overnight sleep.

Stimuli consisted of ten novel concepts, each introduced in the context or five sentences, presented word-by-word to volunteers. Target stimuli (previously unfamiliar word forms with novel concrete or abstract meaning) were counterbalanced between conditions. Three groups (anodal, cathodal, sham) of healthy right-handed native monolingual Russian speakers (age 17–35) took part in the study.

Assessment of semantic learning comprised two tasks:

1) a free-form definition task (DT), in which participants had to describe the meaning of recently learnt concepts in their own terms (accuracy assessed offline by expert evaluations, statistically tested for their coherence using W-Kendall test);

2) semantic matching task (SMT), in which they had to match a concept with one of provided definitions. The overall correctness (correct/incorrect) and accuracy were analyzed using Wilcoxon test (FDR-corrected).

Within-group analysis showed decreased performance of both abstract and concrete semantics on the second day of assessment in both tasks, which, however, slightly differed between stimulation conditions and tasks. A comparison between semantic types revealed significant differences only in DT: higher (concrete > abstract) definition accuracy in the cathodal group on Day 1 and overall correctness in the anodal group on Day 2.

Between-group analysis revealed
1) higher definition accuracy in DT for abstract semantics on Day 2 in the cathodal group as opposed to sham;
2) better overall correctness in DT for the anodal group, as opposed to sham, for concrete semantics;
3) better performance of the anodal (than sham) group for abstract concepts in SMT;
4) no significant differences between the anodal and cathodal groups.

The overall advantage of both tDCS groups over the sham group suggests positive influence of Wernicke's area tDCS on acquisition of novel semantics, whereas the advantage of concrete over abstract semantics supports the well-known "concreteness effect" in semantic processing.

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Understanding action language activates speech-related areas during action preparation in the association learning task

It is generally accepted that language acquisition involves biological mechanisms of associative learning. Particularly, it has been proposed that meaning of action words is acquired as a result of co-activation of cortical areas supporting both speech processing and motor control. If true, such learnt audio-motor neural representations can be retrieved reciprocally, i.e., auditory signal induces the recall of its motor associate, or the other way around. This view suggests that after the concurrent presence of a movement and its auditory associate, as is the case of action word learning, preparation of motor response should activate auditory word representation in the left temporal cortex.

On order to test this intriguing prediction, we used MEG recording during a novel auditory-motor learning procedure. Participants were required to discover novel action words meaning from an association between their movements and pseudowords by way of trial-and-error learning. We explored the magnetic counterpart of motor readiness potential (mMRP), which precedes motor response in a phase-locked manner presumably reflecting motor initiation and planning. Sources of mMRP were reconstructed using MNE software. We expected that as a result of successful auditory-motor mapping, the mMRP would comprise a stronger auditory component at the advanced stage of auditory-motor association learning as compared to initial trials.

Our results revealed that, as expected, apart from classical higher-tier motor regions, the motor response initiation activated the auditory speech areas of temporal cortex as learning proceeded. The auditory activation was phase-locked to movement onset, and lasted from -500 to -150 ms relative to an overt motor response. The learning-related response was found

predominantly in the left hemisphere and involved a widespread network of temporal cortical areas linked to auditory speech processing: STG/STS/MTG, temporal pole, posterior insula, and an area at the parietotemporal boundary.

Our finding is consistent with human and nonhuman primate studies showing cross-modal activation of neurons in the auditory association cortex in response to stimuli of other modalities. The activation of speech areas synchronously with its paired motor associates suggests that the memory for actions is stored in distributed cortical representations including those for related action words.

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Exploring infant vocal imitation in Tadarida brasiliensis mexicana

Bats exhibit vocal imitation, copying conspecifics. What purpose does this rare ability serve? Why is it sustained? The Mexican free-tailed bat roosts in huge colonies in dark caves. Mothers leave pups to forage and must locate their own pup among many static pups each with distinctive vocalizations, each imitating its neighbours. This should produce a cacophony. Computational modelling demonstrates that it does not.

Soundscape simulations

Our model consists of 50x50 'pups'. Each has a distinctive 'call' represented by three real-valued features between 0 and 255, as colours in RGB colour space. At every iteration, each pup alters its call to the mean of calls within radius r.

Attractors rapidly emerge across the colony, eventually amalgamating into a uniform vocalization. If r is smaller, gradients develop more slowly.

If r is larger, they are lost sooner. Statistical noise can cause informative gradients to persist indefinitely. Behaviours are robust for different values of r. Informative attractors only fail to emerge when each individual only learns from the same single neighbour; pups do not need to copy their own mothers to establish a unique bond — they need to imitate promiscuously.

Navigation simulations

Mothers were required to move between pups until they found their pup, within 1000 steps. They were given three search strategies (below), each simulated 10,000 times.

(1) Random walk. The mother moved randomly to one of 8 adjacent pups. She frequently failed.

(2) Lévy flight. The mother drew each random move from a power law distribution. She crisscrossed the colony, but failed as often as the random walk.

(3) Gradient ascent. The mother moved each time in the direction most similar to her pup's vocalization. Local minima caused a random movement. She frequently picked direct, successful routes to the pup, only failing if there was a barrier of dissimilar sounds. Gradient ascent outperformed random walk ($t = 106.0$, $p < 0.001$) and Lévy flight ($t = 106.5$, $p < 0.001$).

Attractor-based guidance was robust, rapidly improved and was sustained over time.

Infant vocal imitation in the large colony of the Mexican free-tailed bat can be adaptive.

We first identified the essential parental behaviour of locating the pup. Second, computational modelling made the effects visible. Apparently complex behaviours emerge from parsimonious biological assumptions.

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Fuzzy phonolexical representations of nonnative words

The models of native (L1) spoken word recognition hypothesize that auditory lexical access involves the competition of the candidates most compatible with the input for selection. Phonological priming experiments with an initial three-phoneme overlap between the prime and the target show inhibition, which is interpreted as a behavioral correlate of lexical competition (Slowiaczek, Hamburger, 1992). It is less clear how lexical competition operates in nonnative (L2) speakers who have smaller mental lexicons and experience difficulties with phonological categorization of L2 sounds (see Gor, 2018). There are reports of 'phantom activation' of irrelevant phonologically confusable competitors in L2 speakers (e.g., Broersma, 2012) that should potentially increase the number of lexical competitors leading to stronger inhibition effects in phonological priming in L2.

We have conducted a phonological priming experiment with Russian speakers and L2 speakers of Russian whose L1 is American English (Cook, Gor, 2018). The goal is to establish whether, indeed, phonological inhibition—an index of lexical competition—is observed in L2 and whether it depends on lexical frequency, a proxy of lexical familiarity. The experiment reports inhibition for Russian prime-target pairs with onset overlap in L1 speakers. When preceded by the phonological prime /kabɨla/, the target /kabak/ (*кобыла* — *КАБАК*, *mare* — *PUB*) takes longer to respond than the same target preceded by a phonologically unrelated word. Adult L2 learners of Russian also show inhibition, but only for high-frequency prime-target pairs. Conversely, they show facilitation for low-frequency pairs. In semantic priming (e.g., *carnation* — *DAISY*), facilitation is observed for the same two lexical frequency ranges both in L1 and L2 speakers of Russian, suggesting that the primes and targets in the low-frequency range are also familiar to the L2 participants.

We interpret nonnative phonological facilitation for low-frequency words as evidence for sublexical processing of less familiar words that is accompanied by reduced lexical competition in L2 lexical access. We posit

that low lexical competition is due to unfaithful, or fuzzy phonolexical representations: L2 speakers are unsure about the exact phonological form of low-frequency words. Weak representations are not strongly engaged in lexical competition.

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Does an only mother tongue matter? The effect of grammatical gender on the objects' conceptualization in Tatar-Russian bilinguals

It has been shown that grammatical gender affects objects' conceptualization (Flaherty, 2000). Specifically, it was revealed that people tend to endow the objects without biological sex by masculine/feminine properties if the linguistic label for the object has the grammatical gender (Phillips, Boroditsky, 2003). Data suggest that the linguistic label being a part of the concept affects people judgment about the object (Boroditsky, Schmidt, Phillips, 2003). It is still not clear, how conceptualization is built in the bilingual mind, especially, when one of the acquired languages does not have grammatical gender. In the current study, we investigate the issue of whether the grammatical gender of the L2 would affect conceptualization in Tatar-Russian bilinguals. Russian (L2) is dominant in the group of the Tatar-Russian bilinguals, whereas the Tatar language (L1) is the subordinate. In the control experiment, we engaged Russian native speakers for participation to test whether the effect of gender works in the chosen paradigm with the current sample. The experiment 2 was carried out with the Tatar-Russian bilinguals.

Participants saw pairs of pictures, with a picture of man or women and the object next to it. The linguistic marker for the object could have the

masculine/feminine grammatical gender. The congruent and incongruent pairs were presented. We hypothesized that people would tend to estimate congruent pairs as more similar than incongruent pairs in the first experiment. We predicted also that the attenuated effect of gender would appear in the group of the Tatar-Russian bilinguals, when instructions are given in Russian. We expected as well that when instructions are given in Tatar, the effect would fade.

Results revealed a strong effect of grammatical gender in the group of Russian native speakers ($F(1, 40)=8.97$, $p=0.005$, $\eta p^2=0.18$), whereas in the group of Tatar-Russian bilinguals, we found only marginal effect of gender ($F(1, 23)=4.25$, $p=0.051$, $\eta p^2=0.16$), even when we tried to boost realization of the differences between languages, using the Tatar and Russian sentence context before the experiment. In a nutshell, experiments showed that the grammatical system of the L2 could have an effect on the objects' conceptualization. In other words, its grammatical system is not acquired as a 'linguistic technic' but affects conceptualization deeply.

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Neural signatures of fast mapping in developing brain: ERP evidence of single-shot word learning in preschool children

The brain mechanisms involved in word learning during childhood remain unknown, and tracking the way new word representations become incorporated into mental lexicon still presents a serious challenge for neuroscience. An associative word learning mechanism known as fast

mapping (FM) is an incidental, exclusion-based word acquisition process that implies inferring a word's meaning from the existing semantic context. Despite numerous behavioral studies supporting FM as a critical word acquisition mechanism, its neurophysiological bases remain obscure. It is assumed that, in children, the learning of new words can occur almost immediately through rapid formation of word-object associations indicating online build-up of new memory traces. To our knowledge, no study has investigated the neural dynamics of this process. To assess it electrophysiologically, the current study used event-related potentials (ERPs) to define brain dynamics elicited by familiar and novel words in young children following a one-trial FM exposure to novel items.

Twelve healthy monolingual Russian preschool children (5-7 y.o.) underwent an FM paradigm: a counterbalanced set of familiar and novel words presented acoustically in conjunction with a visual presentation of respective familiar and novel images. A single mapping trial was administered to allow deriving (by exclusion) the meaning of a novel item from the semantic context. Acoustic stimuli were dissyllabic (CVCV) native word and non-word forms recognized only from their 2nd syllables subsequently used for ERP time-locking. FM task was followed by a passive auditory session in which the stimuli were binaurally presented while EEG (64 channels) was recorded.

ERP amplitudes at 350-400 ms revealed a significant frontally-distributed effect of learning, indicating enhanced neural activation for both familiar and newly trained words but not control pseudowords. LORETA source analysis confirmed this specific increase of activity for the learnt novel items after semantic training to originate in the left frontal and temporal areas.

This study is the first to investigate neural dynamics of single-shot word learning processes in developing brain. Rapid enhancement in neural activations registered after a single encounter with a novel word signifies accelerated plastic changes in brain networks engaged in mastering mother tongue at early ages.

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Neuroanatomical correlates of the written text processing proficiency: A morphometric study of good and poor comprehenders

When investigating the natural reading behavior, we should separate the reading actions in the elementary operations (i.e. word decoding) and the text processing to extract the meaning. Nowadays, there are still few information on structural-functional differences between good and poor adult written text comprehenders. The present morphometric study examined neural differences between two groups of typically developing young adults (18-20 years old) — poor (13: 2 male, 11 female) and good (14:5 male, 9 female) written text comprehenders. Subjects were selected from a group of students (N = 136), as 0-15 and 85-100 percentile, correspondingly, unclearly and clearly understanding the meaning of the read texts (revealed through questions). All subjects underwent a 1-mm isotropic structural brain MRI scans and psychological testing.

It was revealed that the group of poor written texts comprehenders was characterized by lower scores of IQ, memory, reasoning test results compared to good written text comprehenders: 115 [± 13] vs. 127 [± 11]; 5.9 [± 1.7] vs. 6.9[± 1.7]; 11.8 [± 4.2] vs. 16.2 [± 2.8]. We took under consideration gray matter volume and thickness by means of FreeSurfer to figure out intergroup differences and enlarged the psychological based correlations with the use of ROI from VBM. The two-sample T-test was used to analyze differences derived by FS between the poor and good comprehenders in the averaged cortical thickness and relative cortex gray matter volumes in the areas of anatomical defined cortex regions.

We observed the greater relative gray matter volumes in good text comprehenders compared to poor comprehenders in left and right BA6, left and right rostral middle frontal areas, left caudal middle frontal, lateral orbitofrontal, inferior temporal and left paracentral areas. The thickness and volume of the right pars orbitalis (IFG) was greater in poor comprehenders,

the thickness of right rostral anterior cingulate cortex and left fusiform areas was greater in good text comprehenders. The region of interest (ROI) analysis and Spearman correlation was used for the assessment of GMV (delivered by VBM) to psychological parameters relationships in each group separately.

In group of poor comprehenders: IQ scores positively correlated with GMV in temporal zones in the left and right hemisphere BA22, BA42; the memory scores demonstrated significant inverse correlation with GMV in BA39R. The verbal logical reasoning positively correlated with parietal cortex GMV in both hemispheres (right inferior parietal and left superior parietal cortex). The GMV in the left superior parietal cortex positively correlated with the level of written texts comprehension.

In the group of good written text comprehenders, there were revealed four correlations of oral text comprehension with different brain structures — positive correlation were observed with left BA39, Calcarine zone and left superior parietal area, and inverse correlation of this parameter was observed with GMV in associative area BA40 in the left hemisphere. Written texts comprehension inversely correlated in this group with GMV in BA40 in the right hemisphere, the words memory correlated with GMV in left superior parietal area.

The data showed neuroanatomical differences between good and poor comprehenders in the language related networks overlapping with working memory, decision making and conflict monitoring systems.

POSTER SESSION 1

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A quest for phonosemantic universals: Iconicity Atlas Project

An ability to imitate is one of the fundamentals of human psychology. It stretches far beyond simple gestural pantomime and primitive pictographic images as imitation is deeply ingrained into the very core of language in the form of iconic (onomatopoeic, imitative, sound symbolic) words. Iconicity Atlas is an interactive multi-lingual comparative online dictionary of imitative words designed to be a ready-accessible lexicographical tool for typological comparison and psycholinguistic research.

Methods and principles of data selection and representation were as following. Currently Atlas contains 100 most commonly used iconic concepts which serve as a basis for cross-linguistic comparison. The 100-word list is designed after Swadesh list. It contains concepts which are highly likely to be represented iconically in any language (hissing, wheezing, booming, etc.).

The start page of the Atlas (http://www.iconicity-atlas.com) is 'Iconic Concepts', presenting the user with 100 buttons, each indicating one concept and giving access to the entry. Each entry contains the heading, results obtained from the informants in different languages, the IPA transcription, and pronunciation recorded from a native-speaker as well as an extensive commentary with dictionary references.

The process of data collection requires the work with both multilingual dictionaries and native speakers. Informants are asked to fill in a 100-word Questionnaire and to provide a voice-recording of imitative words. Later the data is analysed using methods of phonosemantic analysis (Voronin, 2006), morphological analysis and typological comparison.

Iconicity Atlas is a long-term project. Currently (Feb. 2019) it contains data from 6 languages (Croatian, English, Icelandic, Polish, Russian, Slovak) published online, and data from Vietnamese, Spanish, and five other languages in queue for downloading.

First results show a striking similarity between onomatopoeic words even from different language families. This similarity, however, is not a 100% phoneme-by-phoneme match, as differing phonotactical constraints and differences in phonemic inventories of the languages introduce strict boundaries for imitation. Therefore, only a large scale comparison of imitative lexicons allows to differentiate universal and language-specific in onomatopoeia and to provide an insight into the mechanisms of primarily word coinage, which is the ultimate goal of the Atlas.

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Addressing the replication crisis: The role of language in transcranial direct current stimulation (tDCS) effects on verbal memory

There have been numerous reports of a replication crisis in Psychology (i.e. Open Science Collaboration, 2015), and this may affect studies involving anodal transcranial direct current stimulation (atDCS), a safe method of stimulating the brain by delivering a weak current through the scalp. There has been an inconsistency in atDCS effects reported in verbal memory tasks, including improvements and impairments in performance. Multiple factors could be relevant for explaining this inconsistency: technical parameters, language, and methods of data analysis. Language is reflected in the verbal material (i.e. Russian vs. English) and is particularly important when stimulating the ventrolateral prefrontal cortex (VLPFC), a region associated with verbal memory and phonetic processing in particular (Price et al., 1994; Buckner et al., 1995). Differences in language may explain differences in tDCS effects, since tDCS studies in episodic memory

have been conducted in various countries including Italy, Germany, and England.

The current study aimed to replicate the results of the study conducted in England (Medvedeva et al., 2018; Experiment 1) in a Russian sample, showing the same effect of decreased false recognition. The procedure and materials were replicated as closely as possible, including a translation of the same verbal stimuli to Russian with matched frequency and number of letters. Participants were instructed to memorize a set of words by indicating whether each word was pleasant or unpleasant, and 24 hours later they performed a recognition test.

In contrast to the original study, the current study showed the opposite effect: an increase in false recognition following atDCS. With the expectation that language could play a role in the differences in results, a ROC analysis was conducted to compare English and Russian words in eliciting false recognition vs. correct recognition. No association was found between the words and memory performance, and there was no difference in this association between Russian and English sets.

There may be at least one interpretation: words could be recollected differently based on distinct combinations of sounds (e.g. динозавр). There is evidence that distinctiveness in other word characteristics, such as orthography, can facilitate recollection (Roediger et al., 2001). An initial comparison between the Russian and English sets suggests that distinctive phonology was present in Russian but not in English.

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Analysis of the effects of transcranial direct current stimulation (tDCS) on phonetic and semantic verbal fluency

Currently, there is a large number of research that examine effects of transcranial direct current stimulation (tDCS) on the cognitive functions

of both patients and healthy participants. However, main focus is shifted towards memory, attention, learning, and executive functions separately. The current research is aimed at studying attention, memory and speech inseparably from each other, since it is their complex that makes up the concept of "verbal fluency".

This study is aimed at analysing the effects of tDCS on verbal fluency in healthy volunteers. The study involved 20 healthy individuals divided into active (n = 10) and sham (placebo, n = 10) tDCS groups. The participants completed phonetic and semantic verbal fluency tests, adapted for the Russian language taking into account the frequency indicators, before and immediately after the 10-day course of stimulation. Test materials included letters "П", "О", "К" and categories "fruit and berries" before and "С", "В", "Н" and "jobs" after the course of stimulation. Anodal 1.5 mA tDCS was applied over the left dorsolateral prefrontal cortex (F3 system 10-20) with the cathode on the right shoulder of the participant. Stimulation was carried out once a day in the afternoon, no later than 4 hours before sleep. Additionally, the Beck's (BDI-II) and State-trait Anxiety (STAI-STATE) inventories and tests included in the CANTAB were used to asses mental state, cognitive functions and motor skills of the participants.

No significant intergroup differences were found in the results of the initial and the second testing in terms of the level of verbal fluency. However, a correlation between verbal fluency and a simple sensorimotor reaction was revealed. It was also shown that the frequency of the letter is directly related to the number of answers that participants give to this letter.

Analysis of obtained data led to the conclusion that the effects of transcranial direct current stimulation on the verbal fluency are highly individual. The correlation between the letter frequency and the number of answers in the phonetic fluency task indicates that the tests were adapted into Russian correctly.

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Are all kinds of words recognised similarly?

It has been scientifically proven that sound-symbolic words with a more or less obvious link between their acoustic form and meaning comprise up to 30% of any natural language lexicon (Svantesson, 2017). It has also been established that, in addition to the correlation with the auditory system of perception, sound-symbolism also extends to other sensory modalities (Akita, 2009). Most of the studies, however, focus on the auditory perception of sound-symbolic words, while cognitive mechanisms of processing such words presented visually have not been described yet.

We investigated the recognition of visually presented verbal stimuli by Russian-speaking subjects. The lexical decision method was used in two separate stages of the experiment presenting to the subjects either their native or foreign (English) stimuli. They had been selected according to the criteria we evolved: each sound-symbolic word (20 in total) corresponds to an arbitrary one; each word corresponds to a non-word (40); each pair of stimuli sounds similarly; each stimulus (80) is monosyllabic. A total of 148 people were examined. Their age ranged from 13 to 78, and their English language proficiency — from A1 to B2. In total, 5902 stimuli were presented in the experiment.

The analysis of contingency tables (Chi-square test) and the comparison of means (Student's t-test) have shown that sound-symbolic words are visually identified with more errors and more slowly than similar arbitrary ones, respectively. Chi-square equals 22.606 for English and 25.253 for Russian words, with $df = 2$ and $p < 0.001$ for English and $p < 0.0001$ for Russian words, respectively. Moreover, there was 18.8% and 34.3% variance of the recognition time for English and Russian stimuli, respectively. The analysis of variance ANOVA proved that neither the language of the stimulus (English or Russian), nor the subject's age, nor their English foreign language proficiency influenced the speed and accuracy of their perceiving of the words.

The recorded difference in the cognitive processing of visually presented verbal stimuli must be consequent on the cognitive inequality in the task complexity. It is, therefore, supposed that not only does the process of perception of sound-symbolic words activate the system of cross-modal

interaction, but it also involves the interfering systems of information processing in comprehension of these visually presented stimuli.

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Conventional lexical means for representation of semantics of concepts (Evidence from Russian language)

How can semantic information be accessed by a listener to facilitate speech processing? To answer this question, an empirical study on eliciting semantic features of 10 target nouns, a corpus-based study and a study on predictiveness of context were carried out.

The first part (90 participants) included the task to list essential features for 10 Russian nouns (*a book, a door, a shirt*, etc.) to retrieve the words which are used for semantic description of the concepts they refer to. The words with one and the same root were regarded as pointing the same general feature; they were grouped together and ranked by frequency.

The corpus-based study (Corpus of Spoken Russian: http://www.ruscorpora.ru/search-spoken.html) was conducted to find out whether the obtained feature-words were presented in the nearest contexts ($\approx$ +/– 20 words) of the target words.

In the third part, 240 participants were asked to fill in the blanks in the sentences where the target words were missing. The sentences contained or not the words obtained as semantic associations in the first part of the study. Chi-squared test was applied.

Native speakers tended to use the same words for semantic description of each concept even if they mentioned features of different types. Most of the words were presented among the associations (Russian Associative Dictionary: http://www.tesaurus.ru/dict/index.php) to the target words though their distribution was not the same. Virtually all of the words proposed by the participants for semantic descriptions of the target words were presented in their nearest contexts. The presence of such words in context led to more successful prediction of the target words than their absence (p < .001). The same result was obtained for the conditions when only left context was given.

The results of the study showed that most likely the semantics of concepts is presented in the mental lexicon with the particular words by which the meaning can be expressed verbally. The associative nature of concepts' representations in the mental lexicon and their contextual co-occurrence can serve as a conventional framework of a speaker's and a listener's vocabulary. Such words can be seen as boosts for providing the access to the semantics of a concept and predictors of a certain word appearance quickly, precisely and at the same time flexibly enough as the same word can form different types of features and various contextually relevant semantic categories.

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Cross-cultural speech emotion perception and recognition by means of intonation

The study focuses on speaker's emotional state recognition using prosodic clues alone. Theoretical challenges of emotion classification are considered. Technical approaches to speech emotion recognition are given due attention. The "big six" classification based on the ideas of R. Plutchik (1991), C. E. Izard (1971), P. Ekman (1971) and commonly used in technical applications, as described by T. Seppänen et al. (2003), is chosen and modified to include disgust and shame.

A database of 64 emotional speech extracts in Russian is created. The samples are elicited from 4 speakers of Russian under sound lab conditions. Only 1 statement and 1 question lacking any emotional vocabulary are repeated 8 times by each speaker with different emotions. Praat MFC experiment is created to test the emotion recognition rate. Data are collected from 3 equal groups of 60 subjects altogether: native speakers of Russian, native speakers of Finnish and "internationals" — using chain referral sampling. The subjects are asked to report the emotion they believe to have heard after listening to every speech sample. Randomisation and repetition of stimuli are employed.

A pilot study of randomly selected 5 participants from each group demonstrates that:

1) Speech emotions seem to be cross-culturally recognisable. In the Finnish and international groups, the rate of recognition is 50 %, while probability of guessing by chance is only 12.5 % in each trial.

2) The Finnish subjects are equally good at recognising emotions in statements and questions in Russian, though questions in Finnish are normally not marked by rising final tone.

3) The rate of recognition by native speakers is significantly higher (95 % confidence level is 59±0,72%).

4) No clear correlation between the knowledge of Russian as second language, former exposure to it or musical education/practice and the performance in the experiment was found.

The sample size of the pilot study cannot be a basis strong enough to make final conclusions. The whole sample gathered has to be carefully analysed to check the results and clarify if such factors as gender, age and native language have any impact. We are also going to scrutinise the pairs of emotions most commonly confused by our participants (e. g. sadness and shame). The further research and the emotional speech DB created can be of practical value for linguistics, psychology and language technology.

The methodology of the experiment has been designed under supervision of professor Stefan Werner (University of Eastern Finland).

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EEG correlates of false information processing

Human memory is not a literal record of our experiences but a fallible and malleable cognitive process. Because of the reconstructive nature of memory, we are often prone to accept false events and recall them as

truthful (Bartlett, 1932). One easy and reliable method to create and study false memories in the laboratory is the misinformation paradigm. In this paradigm participants are presented with a story (original information). After some time, parts of this story are presented again but now including some modifications (misinformation). Finally, the memory is measured for the original information, the misinformation, and, as control, some other incorrect information never presented before. The misinformation effect occurs when the percentage of misinformation accepted is higher than the acceptance of control incorrect information. This effect has been largely studied in relation to its applied relevance in eyewitness testimony research. Yet, the neural substrates and temporal dynamics of processing correct and false information remain scarcely studied.

In this study the neural activity was recorded using EEG while participants performed a memory recognition test which comprised misinformation, true, and simply incorrect items. The only previous EEG study on neural correlates focused on misinformation pointed to the P3b and LPC (late positive component) ERPs components as the key to distinguishing between memories for correct and false memories. High P3b is linked with a strong match between the expectation and the stimuli presented. LPC is a late component around 400 to 800 ms after the stimulus presentation, associated with the recollection of accurate information.

Our results show that for the contrasts of misinformation accepted vs rejected, and false information accepted vs rejected (correct rejections), P3b was significantly more positive when the inaccurate information was accepted. These differences suggest a larger cognitive workload on accepting this type of information than when it is correctly rejected. Furthermore, in both contrasts we found differences in P600 which is linked to reprocessing of detected anomalies in the input. Here, we found a more expressed P600 for accepted than for rejected misinformation. P600 was also stronger for correct rejections than false alarms. In this latter case, the higher P600 amplitude may reflect the detection and reanalysis of the rejection of this false information. Interestingly, in the case of acceptance of misinformation, the higher P600 amplitude suggest that participants are not totally blind to the inaccuracy of the misinformation, though still they accept it.

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Effects of bilingualism and culture on language assessment test performance in children: A pilot study of Yamal region

Language assessment instruments should be made in consideration with or adapted to the linguistic and culture specificity. In Russia, there are more than 100 indigenous languages and cultures, however, all the citizens get school education in Russian. To the best of our knowledge, the instruments for language assessment are not standardized with consideration of bilingualism and cultural specificities of the populations.

The current research presents a pilot study as a part of the project of a standardized test adaptation in a group of ethnic Nenets children, both monolingual Russian speakers and Nenets-dominant Nenets-Russian bilinguals. Nenets is a Samoyed language from the Uralic language family with about 44,600 ethnic population.

26 first-graders from the Yamal Boarding School in the town of Yar-Sale, YaNAO took part in the testing: 16 Nenets-dominant bilinguals (M_{age} = 6.7, SD = 0.61) and 10 monolinguals (M_{age} 6.8, SD = 0.63). Their performance was compared to the data collected from children in Moscow and Volgograd.

Binary logistic regression analysis was performed on the results of 6 subtests: Noun Comprehension, Verb Comprehension, Noun Production, Verb Production, Syntax Comprehension, Syntax Production. We were mostly interested in the effects of culture, bilingualism and age. The analysis showed a significant effect of bilingualism in the noun and verb comprehension subtests (β = - .923, SE = .16, z = -5.75, p < .01), noun and verb production subtests (β = - .609, SE = .117, z = -5.21, p < .001) and in the syntax production subtest (β = - .599, SE = .18, z = -3.32, p < .001); a significant effect of culture was revealed in all the subtests analysed (noun and verb comprehension: β = .39, SE = .149, z = 2.62, p < .01; noun and verb production: β = .5, SE = .12, z = 4.17, p < .001; syntax production: β = .799, SE = .132, z = 6.07, p < .001; syntax comprehension: (β = .6,

$SE = .21$, $z = 2.93$, $p < .01$); There was no effect of age in any of the subtests. The analysis also revealed the items to be excluded and replaced by more culturally appropriate ones.

The preliminary data analysis shows different effects of bilingualism and culture factors in different language aspects. The main implication expected is the new test version adapted for the YaNAO. This experience could be applied to adaptation of standardized language tests with regard to linguistic and cultural features of the populations.

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Effects of morphological structure on eye movements in reading Russian by native speakers of Russian and Turkic-Russian bilinguals

The preferred fixating position during reading tends to be near the center of a word. Recent studies by Yan et al. (2014) and Hyönä et al. (2017) have observed an effect of morphological complexity on initial landing position (ILP) during reading of Uighur and Finnish — languages with rich morphological systems but with two different scripts. The present study is aimed at replicating the effect of morphological complexity on ILP and fixation durations found in those studies. Russian is typologically different from both Finnish and Uighur in terms of morphological structure, the script (Cyrillic), and the language family it belongs to. If observed, these effects would provide new evidence for high-level guidance of eye movements during reading as a phenomenon generalizable across different writing systems and languages.

In an eye-tracking experiment native Russian speakers silently read 96 sentences each containing a target word, either a monomorphemic noun or a length- (7–10 letters) and frequency-matched two-morpheme noun (stem + inflectional suffix). 33% of the trials were followed by a

comprehension question. The results were analyzed using linear mixed models in R statistical computing environment.

The preliminary results suggest that Russian speakers (17 participants, 18–25 y.o.) do not process morphological information in the parafovea as there was no effect of morphological structure on the initial landing position or fixation durations. This finding suggests that the effect of parafoveal morphological preview might be language specific. Additionally, we investigated if there was an effect of morphological preprocessing among high functioning Tatar-Russian bilinguals (17 participants, 18–35 y.o.). Tatar is a Turkic language typologically similar to Uighur and Finnish. Considering the fact that there is evidence for morphological preprocessing in those languages, we hypothesised that Tatar speakers might show signs of morphological decomposition in parafovea when reading Russian. The preliminary results suggest that Tatar-Russian bilinguals differ in their reading measures; most notably gaze duration appeared to increase for morphologically complex words. This finding suggests that Tatar-Russian bilinguals might apply a word decomposition strategy found in other agglutinative languages when reading in a typologically different language.

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Effects of three verb argument structure parameters on action naming and sentence production in aphasia

Verb argument structure (VAS) determines the entire sentence structure: that is, the presence, form and order of other words in a sentence. Thus, VAS parameters may influence the difficulty of sentence production in speakers with language disorders, including aphasia. However, VAS parameters other than the number of arguments have

received insufficient attention in previous studies. Our goal was to investigate the effects of three VAS parameters in aphasia in a single experiment: the number of arguments, the canonicity of thematic roles (unaccusativity) and the number of valency options (optionality). We hypothesized that the effect of linguistic VAS complexity would be negative in sentence production but, paradoxically, positive in naming, due to facilitation of lexical access.

Participants were 40 individuals with chronic post-stroke aphasia: 20 with non-fluent (efferent motor and/or dynamic, possibly accompanied by afferent motor) and 20 with fluent (sensory and/or acoustic amnestic and/or semantic) aphasia. They completed two tasks: in action naming, they had to name a picture of an action with one word. In sentence production, they were shown the same pictures but provided with the verb and its arguments and asked to build a sentence using all of these words.

Naming was more accurate for verbs with more complex VAS (transitive than intransitive, $F(1,38) = 10.94$, $p = .002$, and optional transitive than obligatory transitive verbs, $F(1,38) = 3.81$, $p = .058$). Naming was also faster for verbs with more complex VAS (optional transitive than obligatory transitive verbs, $F(1,38) = 10.65$, $p = .002$). In sentence production, sentences were produced less accurately for verbs with more complex VAS (transitive than intransitive, $F(1,38) = 8.289$, $p = .007$, and, as a trend, optional transitive than obligatory transitive verbs, $F(1,38) = 3.27$, $p = .078$). One parameter, the canonicity of thematic roles, had no significant effect in either task.

To summarize, our hypotheses were confirmed. As found in previous studies, more linguistically complex VAS made sentence production more difficult, increasing grammatical processing demands. But in naming, more linguistically complex VAS had a paradoxical facilitatory effect, possibly because it provides more lexico-semantic associations with potential arguments and thus facilitates lexical access to the verb. Thus, verbs with more linguistically complex VAS may provide easier material for assessment and treatment of verb naming.

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Evidence for dual-route morphological processing across the lifespan: Data from Russian number-dominant nouns

One unresolved psycholinguistic question is how multi-morphemic words are processed in the mental lexicon: namely, whether they are accessed directly as single units (full-listing models; Butterworth, 1983), via decomposition into morphemes (full decomposition models; Taft, Forster, 1975), or via a combination thereof (dual-route models; Schreuder, Baayen, 1995). Recent research suggests that the mechanisms may change across the lifespan: with increasing exposure to language, direct access should be favored over decomposition (Reifegerste et al., 2016). The goal of our study is to test these changes throughout the lifespan in speakers of Russian.

We tested 188 individuals of different ages (9–87 years old) on a lexical decision task. Following the experimental design of Reifegerste et al. (2016), our stimuli were Russian number-dominant nouns: i.e., nouns used more frequently in the singular (mother) or plural (eyes) form. Recognition times for such nouns in their dominant and non-dominant forms allow for identification of the mechanisms of morphological processing. We also checked whether processing mechanisms interacted with the type of plural formation: affix addition (glaz — glaz-a, eye — eyes) or replacement (mam-a — mam-y, mother — mothers).

A linear mixed-effect model with random effects for subjects and items was selected with the stepwise algorithm in the lmerTest package in R. ANOVA tests showed a significant interaction between number dominance and form (p < .001) and no three-way interaction with age, favouring the dual-route model for participants across ages. There was also a main effect of age-squared (p < 0.001), meaning that the effect of age was U-shaped. Finally, there was a significant interaction of age-squared and type of plural formation (p < .001), suggesting that plurals with replacement are more difficult to process for younger people.

The results show that morphological processing mechanisms in Russian seem to be consistent with the dual-route model and persistent across the lifespan, contrary to the hypothesis. The absence of interaction between the type of plural formation and form suggests that citation (singular nominative) forms with and without overt ending are processed similarly: they are stored in the mental lexicon rather than decomposed, regardless of their morphological structure.

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Functional brain mapping of speech areas and tracts in pre-surgical preparing of patients with brain tumors

In modern neurosurgery, the most important role is assigned to save the patient's quality of life after surgery, namely, such an important function as speech. To help neurosurgeons determine access to a tumor during surgery, determine the location of functionally important speech zones and tracts, and to track the dynamics of the patient's condition before and after surgery, special protocol is needed for the best possible preoperative preparation that would be effective for intraoperative mapping and for developing follow-up rehabilitation.

As part of a multidisciplinary team we have developed a preoperative MRI protocol for patients with brain tumors in the dominant speech hemisphere.

This protocol was applied to 4 patients with tumors in the left hemisphere. All patients were right-handed. The scans were performed on a Toshiba Vantage Excelart MRI scanner 1.5 T. A standard MRI scan, DTI, and a functional MRI scan using paradigms for mapping functionally significant areas were performed (headphones, screen, and joysticks Nordic Lab were used). All patients underwent a dichotic audition, an Annette

questionnaire to determine the profile of lateralization. Post-processing of the data was carried out in the software environment Nordic BrainEx (Nordic NeuroLab).

During the post-processing of the obtained data, the motor and sensory speech zones were distinguished (Broca's, Vernike's areas, angular gyrus), their location relative to the formation was determined and the conductive tracts that were involved in the process of speech were distinguished, namely: Fasciculus Arcuatus, Fasciculus Uncinatus, upper longitudinal, lower longitudinal and frontal — temporal tracks. The obtained data was transmitted to the neurosurgeon to determine the optimal access to the tumor, as well as for intraoperative navigation.

On the basis of the obtained data, microsurgical removal of the tumor under the control of ultrasound navigation, neurophysiological, neuropsychological and neuro-linguistic monitoring in conditions of awakening. In the course of intraoperative mapping, functionally significant zones, obtained during fMRI mapping, coincided with those identified during the operation.

The proposed protocol can be used in the framework of preoperative preparation of patients with tumors in functionally significant areas, in particular, speech.

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Functional connectivity during written text processing in adolescents and young adults: EEG study

Brain base for the written text processing has multilevel organization. The higher level of text processing includes analysis of semantic, syntactic, discourse, inferences and others. The definitive level for this complex skill is formed rather late in ontogenesis.

Both brain maturation and skill improvement affect the neural pattern of activation during text processing. Both mature brain structure and effective brain regions functional connectivity is required for text processing. The study is devoted to investigation of the age and sex differences in the formation of functional systems providing written text processing in adolescents (12-17 years old) and young adults (18-25 years old).

We studied the process of functional integration of different cortical areas during narrative text reading in adolescents of 12-17 years old (N=85, 30 males) and young adults 18-25 years old (N = 46, 20 males). Using the cross-correlation analysis of EEG matrix, the contribution of each cortical area in the spatial synchronization of biopotentials (SSBP) was assessed. To study the influence of factors Age, Sex on the EEG parameters ANOVA was estimated.

Significant effect of the 'Age' and the 'Sex' factors on the total SSBP level was revealed. When reading texts compared with the wakefulness with the eyes open state, all subjects showed the SSBP levels decrease in central cortical areas, indicating possible activation of the motor cortex. In males, reading the text caused the SSBP levels increase in the parieto-occipital areas. With age, there was the SSBP levels increase of the frontal areas bilaterally and in the right temporal area (T6). In females, SSBP levels decrease of the frontal zones and increase in the temporal (T4), parietal (TPO) and occipital (O2) areas of the right hemisphere between adolescence and adulthood.

Text processing causes age and sex differences in spatial synchronization of brain biopotentials (SSBP). Males showed SSBP levels gradual age increase in the frontal cortical areas during reading, while females showed another tendency: frontal cortical zones SSBP levels gradual decrease and parietal-occipital regions increase from adolescence to adulthood. The data obtained may indicate sex differences in the maturation trajectory of the central mechanisms of text processing, which could be associated with the frontal regions pathways myelination process.

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Intensive language-action therapy combined with anodal tDCS leads to verb generation improvements in non-fluent post-stroke aphasia

Previous studies of effects of intensive speech training in chronic post-stroke aphasics showed complex improvements in speech function. Additional means that may help induce neural plasticity in patients' language-specific brain areas are offered by non-invasive brain stimulation techniques such as transcranial direct current stimulation (tDCS). However, it is still unclear whether any training- or stimulation-related improvements are driven by specific language recovery processes or are caused by general cognitive enhancement due to therapy and spontaneous recovery.

In our study, 17 patients with chronic non-fluent mild-to-moderate aphasia caused by a single stroke of the left middle-cerebral artery underwent Intensive Language-Action Therapy (ILAT) training course combined with either 1.5 mA anodal tDCS over left IFG or sham tDCS. We hypothesized that tDCS could facilitate speech training effects. To assess therapy-related changes in speech production, we applied verb generation task before and after training, using two different sets of words. Patients had to respond to a visually presented noun by uttering a related verb. There was an easy condition ("sun->shines") and a difficult one ("island->emerges").

We found that the number of correct responses increased after the training course, as indicated by repeated measures ANOVA. This increase

was significant in the difficult condition (F = 6.9, p < 0.02) but not in the easy one (p > 0.5), where most patients could perform well already before therapy. The response times also improved for the difficult condition only (F = 5.04, p < 0.04). As for the tDCS effect, there were no significant effects of sham/anodal tDCS assignment or its interactions with behavioral outcomes, which could be due to small sample size.

In sum, the analysis showed that speech production significantly improved after the combined ILAT-tDCS training. However, the significant improvements were observed only in the condition where the speech production was more effortful. This might be an evidence that these improvements were driven by non-specific processes associated with attention and cognitive control functions involved in speech production. While these effects seem to be driven by speech training rather than by tDCS, future studies should use larger samples as well as different polarities and sites for stimulation to scrutinize its effects more closely.

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"Kind of, well, you know": Speech disfluencies and gesticulation

Gesturing is considered supplementary to speech in natural communication: words transfer the core meaning, while hand movements amplify or complement the message. Gestures are supposed to serve as a compensation with speech disfluencies (Kita, 2000). There are two main explanations of the help gestures provide with speech pauses and self-corrections. The first one pays attention to the lexical access in the speaker's memory (Hadar, Butterworth, 1997), while the other one takes into account conceptual tasks and information processing (Alibali et al., 2000; Kita, 2000). Considering these hypothesis we can assume that gesturing will

increase during speech disfluencies. However, there is a research showing that speaker's problems lead to stops in gesturing (Graziano, Gullberg, 2014), so the decrease in gestures can be expected. It is clear that the complex interplay of gesture and speech is determined by many different factors.

To study the changes in gesturing during speech disfluencies we used the multimodal resource "Pear Chats and Stories". As speech disfluencies we considered filled pauses and self-corrections and then contrasted them with gestures classified into functional groups. Total length of the video subcorpus used for the analysis was about 2,5 h.

We addressed elementary discourse units (EDUs), which are determined on the basis of prosodic characteristics and usually coincide with syntactic clauses.

	Total	With gestures	
EDUs with self-correction	268	167	62%
EDUs with filled pauses	324	218	67%
EDUs interrupted by another participant	50	19	38%
EDUs with any kind of disfluencies	524	308	59%
EDUs without disfluencies	1549	711	46%

Table 1. Speech disfluencies accompanied with gestures.

Table 1 shows that gestures more often accompany EDUs with hesitations and (self)interruptions than fluent ones, except for the cases when interruptions were induced by another person ($p < 0,01$). EDUs with filled pauses are accompanied by gestures more often than EDUs with self-corrections.

As for functional types of gestures, we distinguished depictive, pointing, pragmatic and beats. Depictives and pragmatics (generally corresponding to iconics and metaphorics in McNeill's classification) are related to self-corrections more than to filled pauses and much more than to interruptions induced by an other participant, while pointing gestures, in contrast, are more often used with pauses and especially with interruptions. We suppose this is due to their connectedness to interaction between participants rather than to described events.

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No more words? Cognitive features of reading verbal texts and infographics

The illustrations in the text reduce the cognitive load and help to build up mental images (Glenberg, Langston, 2005). However, other studies show that illustrations make reading more complicated as they require high attention control (Mayer, 2005). Previous results indicate that people respond better to the questions after reading a text in case it was presented in a form of infographics, whereas verbal texts are better in terms of their general understanding (Petrova, Riekhakaynen, 2019). The purpose of our study was to investigate the patterns of cognitive behavior manifested during processing of texts of various formats (verbal ones and infographics). We tested the following hypothesis: the level of comprehension and self-evaluation of comprehension of texts of various formats is different.

The stimuli material was presented by three pairs of texts of different formats (verbal and infographics). 40 respondents (aged 18 — 37, M = 22; 77.5% female) were asked to read two texts in the pseudo-random order. Then, they had to answer a test based on these texts, self-estimate the level of texts' comprehension, and answered the questions of semi-structured interviews. The interview protocols were scored by two experts according to the texts' comprehension criteria. The data was analyzed with concordance (Kendall's W) and comparative analyzes (Mann–Whitney U-test, chi-squared test).

No differences were found between the scores for the tests (U = 618.5; p = 0.08) and the level of comprehension (c^2 = 0.584; p = 0.631) of texts of various formats, except for the most complicated one (in the subjects' opinion). The test scores for the latter one were higher when working with verbal format (U = 21.5; p < 0.01). Self-evaluation of the comprehension of verbal texts was higher than that of the infographics (U = 455.0; p < 0.01).

Presumably, the results were related to the difficulties in parallel cognitive processing of graphic and verbal elements of infographics. The respondents experienced the following issues while reading infographics: the analysis of the graphic structure of the text; understanding cultural graphic codes; building up the links between verbal and graphic elements of the text;

converting mental representations into the verbal form with no distortion of the key terms. To conclude, the comprehension of a text depends on its content more than on its format. However, the qualitative specificity of cognitive behavior manifested during reading of infographics was described.

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Perceptual priming and syntactic choice in Russian language: Multimodal eyetracking study

Perception provides an input of information about the event, attention foregrounds relevant information for the conceptual analysis, and subsequent language production mechanisms collaborate to generate speech (Levelt, 1989). A part of this complex process is selection between available syntactic alternatives. Existing evidence suggests that the system responsible for assigning the grammatical roles is sensitive to the distribution of the speaker's attention within the described scene (Myachykov, Pokhoday, Tomlin, 2018). This indicates a regular interplay between attention and syntactic choice. Previous experiments, however, exclusively used variants of the visual cueing paradigm (Posner, 1980). Thus, the reported link between attention and syntactic choice cannot be generalised beyond the visual modality. A multi-modal nature of attention needs to be addressed as well.

Participants (N = 72 native Russians (40 females, age M = 23.1, SD = 2.83)) described transitive events (Pokhoday et al., 2018) following either visual (Exp1), auditory (Exp2) or motor (Exp3) lateral cues to (1) the agent or (2) the patient. Fixations and verbal responses were recorded. A within subjects, within-items design was used with Event Orientation and Cue Location with 2 levels (2x2). DV — the proportion of cued referents' assignment to the most prominent position in the sentence. Analysis — GEE Binomial Logit Model (SPSS 24).

Exp1 a main effect of visual cue location: $X2(1) = 4.15$, p=.042. A main effect of event orientation: $X2(1) = 3.91$, p = .048. No interaction. Exp2 no effect of auditory cue. A main effect of event orientation: $X2(1) = 5.23$, p = .022. Exp3 main effect of Cue Location: $X2(1) = 4.04$, p = .04. No effect of Event Orientation: $X2(1) = 0.1$, p = .99.

In Visual and Motor experiments, primes biased syntactic choice in a similarly to earlier studies. In Auditory priming experiment — no main effect was registered. In Visual and Auditory experiments canonicity of event orientation proved to be an important factor in structuring sentences in Russian language. Two points can be concluded: (1) during sentence production syntactic choice is partially driven by attentional cues in Russian language; (2) event orientation may influence the order Russian native speakers mention referents.

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Realizations of frequent word forms in children's speech: Evidence from Russian

The research of phonetic realizations of frequent word forms in spontaneous speech is crucial for understanding the mechanisms of speech processing. Word frequency is one of the factors that actuate phonetic reduction. There is an assumption that at least the most typical reduced realizations of frequent word forms should be stored in the mental lexicon of a native speaker along with the canonical ones. If it is the case, it is important to know how and when such reduced realizations are acquired during first language acquisition.

The question we are going to answer is whether reduced variants of frequent word forms appear in children's speech by the age of four (when a child without speech disorders already is able to produce short narratives).

We recorded the speech of 71 kindergarten students aged four to six years (26 boys and 45 girls). During the experiment, children had a short introductory chat with the tester and then played shopkeeping being first a shop-assistant and then a customer or vice versa. The majority of questions asked by the tester urged the children to use the word forms that often undergo reduction in adult speech (such as *zdravstvujte* 'hello (formal)', *spasibo* 'thank you', *kogda* 'when', etc.). The experiment with each child lasted from five to ten minutes. The overall duration of the records is 596 minutes.

We extracted from the records and transcribed 1200 realizations of 22 different frequent wordforms. Although more than 70 percent of these realizations turned out to be unreduced, we found at least one reduced realization of the wordforms in focus in the speech of every child who took part in the experiment (for example, [stoka] for *skol'ko* 'how many / how much'; [kada] for *kogda* 'when', etc.). Highly reduced realizations are rare in children's speech, the omission of only one or two sounds being more frequent. Even the wordform *sejchas* [sʲitɕæs] 'now' which is normally pronounced as [ɕæs] by adult native speakers of Russian stayed unreduced or was pronounced with the omission of only one sound (the first vowel [i]) in the majority of examples. Thus, we can conclude that by the age of four Russian speaking children already start acquiring the reduction mechanisms, but this "aptitude" develops gradually.

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Resting state EEG differences in dyslexic and typically developing children aged 9–13 years

Dyslexia is the learning disorder that specifically impairs a child's technical reading ability. The structural and functional neuronal

connectivity provide information integration, which underlay higher brain functions, such as language. We hypothesized that disturbance of time and space course of neuronal ensembles synchronicity may underlay language disorder. The basic features of neural synchronicity are reflected in resting state EEG organization. Therefore, we investigated the background EEG differences between typically developing children (TD) and dyslexic patients (DYS).

Twenty-five DYS children (9–13 y.o., 16 males and 9 females), twenty-five age and sex matched TD children took part in the study. Eyes-closed rest EEG was recorded at 19 sites. The power of six EEG bands in the range of 0.5-30 Hz was estimated using spectral analysis in order to investigate resting state neural synchronization.

We studied separately participants with the hypersynchronous (GIP) EEG type and normal EEG. Compared to the TD children (n=21), the DYS children with the normal EEG type (n = 18) showed significantly lower spectral power of EEG alpha1-band oscillations ($F_{(1;37)} = 11,425$, $p = 0,01$) in all parietal and middle-central brain regions. This effect was not shown in participants with the GIP EEG type, but hypersynchronous EEG was noted more often in DYS children (n = 7; 2 females, 5 males) then in TD children (n = 4; 1 female, 3 males). There was a significant difference between the DYS and TD children on the combined frequencies of six EEG bands ($F_{(6, 166)} = 13.645$, $p < 0.0001$; Wilks' $\Lambda = 0.670$); dyslexia patients had less frequency in the same bands.

It was shown that DYS children with the normal EEG type had lower alpha1 power in all parietal and Cz regions, lower frequencies of EEG bands and GIP EEG was noted more often in DYS patients. We suppose that lower frequency and excessively high synchronization can underlay dyslexia because of decrease in the lability of nervous processes, slows down switching between different brain regimes and, therefore, cause difficulties in cognitive activity.

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The connection of lateral preferences and the level of intelligence with the severity of speech problems in preschool children

It is known that speech is a lateralized function. There is an assumption that at least some of the speech impairments are associated with the type of children lateral preferences. We compared the severity of speech impairment with four groups of tests aimed at assessing peripheral and central asymmetry.

We have used the following methods: 1) dichotic testing; 2) three tests that are considered in the literature as having a genetic basis (finger grip, Napoleon's test and shoulder test), 3) tests that are under social pressure (close and open the lid of the jar, take an object from the table) and 4)"magic pouch" — a test in which the child is asked to identify the object by touch in a closed bag with each hand and name it.

96 children were examined, all children visited kindergarten. The age of children at the time of the survey was 5.2–7.8 years. Among them, 30 children had no diagnoses, including speech, and 66 children had diagnoses in accordance with the classification by R. E. Levina (phonetic-phonemic underdevelopment of speech, general underdevelopment of speech of the 2nd and 3rd levels).

Regression analysis revealed a relationship between the severity of speech disorders and the magic pouch test (β = -0.240, R2 = 0.058, $p \leq 0.05$). Therefore, the better the child identified the objects with the left hand, the more likely was the presence of speech problems. Moreover, the severity of speech problems was associated with the results of the assessment of general intelligence using Color progressive matrix by Raven (β = 0.228, R2 = 0.052, $p = 0.05$).

Test " magic pouch" evaluates not only a specific feeling — tactile — but also the integration of many sensory channels. The following explanation for the connection of its results with speech problems is possible: the more the left signs indicate is in a subject, the slower myelination of the brain is. Perhaps, this slow myelinization influences the integration of information

and, thus, affects the formation of speech. This may also affect the effect of its results on more complex series of Raven test.

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The development of the speech expression of fear in early childhood

We have investigated means of expression of the emotional state of fear in typically developing Russian children aged from 9 months to 5 years. The aim of this study is to find out the time of emergence and the dynamics of speech expression of one's own and other persons' emotional states. We regard fear as an emotional situation schematically consisting of: *a cause* of a certain condition; a way of the influence of the factor *contact*; the *condition* itself; *a reaction* following this state.

We have used both longitudinal children's speech recordings (14 children aged from 9 months to 3 years) and narratives based on pictures produced by children aged 4–5 years. The data have been provided by Children's Speech Data Foundation. 650 statements with the semantics of fear have been analysed.

The first statements about one's own state appear at 1.0–1.1 years. The most significant component was the cause. The telling about other persons' conditions starts at 2.3–2.5 and is focused on the reactions.

Children start using special emotive lexicon to describe individual condition at the age of 1.9–2.0, after a long time since the appearance of the corresponding semantics. Children tend to use verbs (to fear), adjectives (horrible) and nouns (horror). Children use special emotional vocabulary to describe the condition of other persons since the age of 2.3–2.5: "she is afraid of the ghosts!" The verb model (to be afraid, to scare) was the most common in our data.

The number of the components of the emotional situation in the utterances expressing speakers' own fear starts increasing (>2) at the age of

2.2–2.5. When children talk about the emotional state of others, an increase in the number of the components was observed from the age of 2.6–2.7.

When children talk about themselves, the utterance is structured in such a way that the cause usually precedes the condition: "The dog swears, Denis is scared!" (2.4); "I am not afraid of pigs" (3.1). When children talk about others, the condition precedes the cause and the reaction: "The mouse was afraid and ran into the hole" (4.2).

Expressing individual emotions, a child focuses on the subject of the emotional state. Describing the emotions of other's, the emphasis shifts to the situation in which this state can be experienced. Verbalization of the emotion of fear develops accordingly to the formation of the "theory of mind".

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The early stages of personal discourse acquisition

Development of early communication skills plays an important role in a personality formation. Personal narrative competence considered to be closely related to a construction of identity and so-called 'autobiographical self' (Bruner, 2004). However, we still lack studies in the early personal discourse acquisition, despite a long history of developmental psycholinguistic studies. Following numerous longitudinal studies in language acquisition, one can presume that the earliest discourse genres are a daily conversation and personal/fictional narratives. Still, one of the key questions is: how are the early personal discourse competence and everyday life experience interacting? How are related to each other, in the process of discourse acquisition, daily conversation and narrative competence? In the current study, we aimed to evaluate macrostructural characteristics of early personal narratives elicited in the flow of conversation between an adult and a child.

The subjects of the study were 24 Russian typically developing young children. Here, we focus on the first wave of a longitudinal (2018–2020) study when the mean age of the subjects was 49 months, i.e. the initial stage of the most critical period for the personal discourse development. The

data of personal narratives were elicited by means of the Conversational Map Elicitation Procedure (Peterson, McCabe, 1983). The sessions were audio-recorded and transcribed for a pragmalinguistic analysis.

Our results proved that at the age of fourth, the children were able already for proper modifications of speech and communicative strategies in accordance with the requirements of the genre (daily conversation vs. narrative), but these skills still depended on the interlocutors' communicative behavior. In the presentation, macrostructural and discursive similarities and differences between the genres of the personal discourse will be further discussed.

Although the study is still at the initial stage, the results shed a light on the first emergence of personal narratives in the context of the daily conversation and revealed a complexity and variety of different linguistic and communicative skills necessary for successful switching between genres of personal discourse.

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The effect of visual noise on good-enough language processing in reading: An eye-tracking study

Good-enough language processing is a theory in psycholinguistics that says people are more likely to rely on lexical-semantic heuristics and language experience than algorithmic syntax processing in situations of bigger cognitive load. Unlike deep algorithmic processing, this mechanism can lead to incomplete or erroneous understanding of the sense of a phrase, such as interpretation of the word "dog" as a subject in a phrase "The dog was bitten by a man". Despite the fact, that there are many works on GE-processing and this research topic is attracting increasingly more attention, the reasons why people rely on GE-processing are still not studied. My work is concerned with studying the linguistic visual noise as a factor capable of increasing the degree of reliance on GE-processing.

In order to understand how much this noise influences GE-processing, I have conducted two experiments (with and without noise) on the material of syntactically complex unambiguous sentences that contained an adjunct that was attached to a complex noun group and was expressed by a participle clause (in Russian). These sentences were divided into "plausible" ("Я поздоровался с учителем школьника, держащим в руках указку") and "implausible" ("Я поздоровался с учителем школьника, одетым в школьную форму") depending on their meaning. The rightness of interpretation of their meaning enabled me to assess the degree of reliance on GE-processing. The testees were 22 neurologically healthy people, Russian native speakers (age: 18 — 38 years, average 23 years, mean 4,7 years, 4 males and 18 females, 19 right-handed and 3 left-handed.) In my research, I applied eye-tracking method as ecologically valid and the most precise. For the data analysis I used statistical analysis in R and repeated measures ANOVA in SPSS.

The following variables have proven to be statistically significant: plausibility for dwell time ($p = 0,027$); visual noise for dwell time participle fixations ($p = 0,031$); noise for accuracy ($p = 0,0002$).

People spent more time for reading implausible sentences which is quite predictable. What is more, they were more attentive while reading participle clause in noise conditions as they spent more time reading them. The most surprising thing was that testees were more accurate in interpretation sentences in noise conditions. This fact allows us to discuss future plans for conducting experiments to compare different types of noise.

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The N2b and P3b in adults with an experience of institutionalization

There are studies showing that children with experience of institutionalization demonstrate cognitive deficits (Bakermans-Kranenburg

et al., 2008). Adults with such experience in childhood demonstrate atypical brain functioning (Hanson et al., 2009). Now the delayed effects of early institutionalization are not sufficiently described. This study examines the impact of institutional care on brain function in adulthood.

We compared two groups of 43 adults with a history Institutional care (IC) and 41 adults raised by their biological family (BF). We used a simple auditory task in which subjects indicated when a randomly occurring target tone (high pitch) was presented in a series of standard (low pitch) tones. Electroencephalography (EEG) method was used to study brain electrical activity. P3 and N2 components were examined as markers of stimulus evaluation, selective attention, and conscious recognition (Duncan et al., 2009).

Significant differences in the P3b were not found, but we indicate that group IC produce lower N2 amplitudes than BF group. A significant difference in amplitudes N2 between groups on Target stimuli were shown in Midline Frontal, Right-Anterior clusters. The results indicate that IC group produce lower N2 amplitudes than BF. For Standard stimuli significant difference in amplitudes were shown in Midline Frontal and midline central clusters. The results indicate that IC group produce lower N2 amplitudes than BF.

The differences between the amplitudes of N2 in the IC and BF groups also can be explained by the difficulties in keeping attention and concentration. Since components N2 and P3 are jointly involved in the cognitive processing of information we expected to see a decrease in the amplitude for the IC group in the component P3. We can assume that a more significant difference between people with experience of institutionalization and without it occurs at the stage of classification of the stimuli, but the process of decision-making are similar. Further research may reveal differences in the P3 component in people with IC or provide new evidence to support the lack of differences.

In our study, there is a non-uniformity for age in the groups of IC and BF. We continue to analyze data and the groups will be aligned in the future.

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The role of attention in visual language information processing: An EEG study

Automaticity in language processing has been a debated issue. Previous research in auditory modality shows that strong connections within lexical circuits determine activation independent of attention/inhibition. In contrast, pseudowords activate several circuits partially - the activity is dependent on the inhibition level. Yet no experiments with control for attention in visual modality, as well as investigation of automated semantic processing, have been conducted before. Moreover, there exists a consistent controversy as to timing and localisation of automated responses.

We conducted an experiment with 128 EEG channels recording. The stimuli included Russian words vs. pseudowords vs. non-words as controls. Words sample was split into 100 action vs. 100 non-action words. The task was to find on the screen either a letter combination (attend condition) or color pattern (non-attend). We predicted stable activation for words, activation for pseudowords dependent on attention, and additional activation for action words in sensorimotor cortex (embodied semantics hypothesis).

The results indicate three stages of visual processing: 140 (pre-attentive/ automatic), 240 (attentional) and 300 ms (reprocessing). At 140 and 300 ms, the responses for words had smaller range than for pseudowords (statistically significant). There was also evidence for semantic processing at 140 ms and reprocessing at 300 ms, with additional activation in motor cortex. As to the topography in general, attended stimuli exhibited strong central negativity and occipital positivity at 240 and 300 ms. Both words and pseudowords elicited fronto-temporal right and left-biased responses in non-attend condition and more central responses in attend.

Our results support hypothesis for more stable activation for words at 140 and 300 ms. In general, our study confirms the multi-stage processing model, the intervals being in line with previous studies. Nevertheless, we didn't find any significant traces of "ultra-rapid" lexical activation (around 30-70 ms), due either to vulnerability of these earlier peaks or to the lack of response. The topographic results, while consistent with the traditional account for linguistic processing in left frontal and temporal regions, also provide evidence for activation in the right hemisphere, and suggest a distributed network of language processing. The additional activation in motor cortex for action words is in line with the embodied semantics hypothesis.

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The roles of major associative white matter pathways in language processing

Current neuroanatomical models of language processing point to a critical role of white matter tracts in language processing; data on the relation between tracts' disconnection and the accompanying language deficits are, however, fragmentary. Previous studies show that disconnection of the arcuate fasciculus (AF) impairs language production, whereas damage to the ventral tracts leads to a more specific deficit in lexical-semantic processing (Catani, Mesulam, 2008). The current study aims to systematically reveal a relation between tracts damage and deficits at various aspects of language processing.

35 Russian-speaking right-handed patients (age range: 18–60 years) undergoing brain surgery in the left hemisphere took part in the study. Language assessment was performed before and after surgery using the Russian Aphasia Test (RAT; Ivanova et al., 2013), tapping into all linguistic levels of language processing in both production and comprehension modalities. Patients underwent diffusion-tensor imaging before and after surgery; the data were preprocessed in FSL and ExploreDTI, then TracVis was used to reconstruct AF, frontal aslant tract (FAT), inferior fronto-occipital, inferior longitudinal and uncinate fasciculi (the ventral tracts).

We observed a significant correlation (p < 0.007) between smaller postoperative volume of the AF and language production worsening (average production score). Among RAT production subtests analyzed separately, however, only repetition scores demonstrated a significant positive correlation with AF volume. FAT resection was associated with worse discourse production. No correlation between damage to the ventral tracts and comprehension scores was found.

The obtained results are in line with the existing data on the role of the white matter tracts in language processing and suggest that the language production impairment following AF disconnection may be driven specifically by a sensory-motor integration deficit. A correlation between FAT volume and discourse production supports its critical role in spontaneous speech production.

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Understanding of ambiguous texts in people with various patterns of metacognitive regulation of emotions

Emotions play an important role in solving various cognitive tasks, including understanding of ambiguous texts such as fables (Moiseyeva,

2017). Understanding of these texts requires both developed conceptual thinking and a system of cognitive and affective regulation. This implies that metacognitive regulation of emotions contributes to the process of understanding fables' gists.

Twenty volunteers participated in our study. We used in-depth semi-structured interview based on nine Aesop's fables (3 sets, 3 fables each). The task was to interpret each fable and formulate its gist. Interpretation of each fable was scored 0, 1 or 2 depending on whether it was concrete or generalized (Shcherbakova, Nikiforova, 2018). Additionally, participants were administered several questionnaires and tests: «Cognitive Regulation of Emotions Questionnaire» (CERQ) (translated and adapted from O.L. Pisareva, A. Gritsenko); «Raven's Standard Progressive Matrices Test» (SPMT); «Questionnaire of emotional intelligence» (EmIn) by D.V. Lyusin; «Reading the Mind in the Eyes» (adapted from E. E. Rumyantseva). Participants were tested individually. Each session lasted up to two hours.

Correlation analysis (Spearman's Rho) showed that level of theory of mind (measured with «Reading the Mind in the Eyes» test) positively correlated with negative patterns of metacognitive regulation as "self-blaming" ($r = 0,48$; $p < 0,05$), and "rumination" ($r = 0,4$; $p < 0,05$). Theory of mind negatively correlated with positive patterns "positive refocusing" ($r = -0,39$; $p < 0,05$) and "putting things into perspective" ($r = -0,44$; $p < 0,05$).

There was a tendency of negative correlation between understanding of fables and positive patterns of metacognitive regulation of emotions ($r = -0,32$; $p = 0,088$). The result contradicts our initial prediction, but suggests that people who tend to use positive regulation patterns, may use fables as triggers for reflecting on their own real-life current experience rather than processing texts themselves. This may lead to lack of understanding fables gists. Overall, the results suggest that reading fables may cause actualization and modification of a reader's affective processes. It is possible that increasing the number of participants will allow the tendencies to reach significance.

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Verbal description of emotional and physical states in narratives produced by speakers in different language proficiency levels

Russian language provides different means to describe one's emotional or physical state. All verbal means can be divided into direct and indirect types. Direct means are verbs (predicative models), adjectives, prepositional phrases, interjections etc. Indirect description is present when reasons, features or subject's actions are spoken of, but the emotion or feeling itself is not named. The goal of our study is to find out if it is language proficiency or cognitive development that influences different ways of verbalization of the emotional/physical state.

The data are Russian language narratives produced on the base of pictures. The informants were: normally-developing Russian-speaking children (age 4–5 years, n = 20; RC), SLI Russian-speaking children (age 4–5, n = 20; SLI), Russian-Swedish bilinguals (age 7–9, n = 18, BL), Russian-speaking adults (age 18–20, n = 29, RA), and Russian as a second language learning adults (age 20–25, n = 23, RSL).

The emotional state was described by the following number of participants (% of participants who has spoken on the character's state in general at least once / % of those who used direct means / % of those who used indirect means): RC 63/60/40, SLI 50/46/54, BL 44/35/9, RA 97/88/61, RSL 89/86/54. The same measurements for the physical state are as following: RC 78/60/40, SLI 46/43/45, BL 16/14/2, RA 88/32/82, RSL 56/27/35.

Adults in both groups described inner states more often than children. This proves the statement that the ability to focus on other's state is mostly determined by the development of cognitive mechanisms. As for the lexical variety, monolingual participants showed the best results. In children groups, RC used various direct and indirect verbal means more often than BL and SLI, and SLI's narratives featured higher lexical variety than BL's narratives. BL tend to use direct verbal means, and their vocabulary is

limited. In adult groups, RSL, like BL, use indirect means less often than RA. The fact that second language acquirers prefer direct means to indirect may be due both to their lack of necessary vocabulary and difficulty to express indirect meanings in a non-native language. This allows us to conclude that speaker's choice of means of description of emotional and physical states is mostly related to the language proficiency level, while the general ability to express inner states depend on the cognitive development level.

POSTER SESSION 2

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A link between vestibular dysfunctions and cognitive level of school children with difficulties in reading and writing skills

Nowadays a link between cognitive impairment and vestibular dysfunctions of children is not sufficiently explored. However, a growing number of computerized research acknowledges its existence. The purpose of the research was to search for connections between a level of non-verbal intelligence and intensity of vestibular disorders of school children with difficulties in reading and writing skills.

An otolith function was evaluated by recording cervical vestibular evoked myogenic potentials (cVEMPs) with Neuro-MEP-4 electroneuromyograph (Neurosoft, Ivanovo, Russia). The latency of P13 and N23 was measured ipsilaterally from m. Sternocleidomastoideus (saccule and cervical reflex). Functioning of semicircular canals was evaluated by recording post rotational nystagmus using Rehacor-T psychophysiological telemetric system by MEDICOM-MTD Company (Taganrog, Russia). A test subject was placed in a sedentary position on the Barani rotational chair. The head was tilted forward at an angle of 30 degrees. The horizontal component of EOG was recorded with the help of two EOG derivations, with two electrodes placed on the lateral angles of eyes, and one neutral on the forehead. The chair was rotated manually at a speed of 10 rotations in 20 seconds. After rotations, a post rotational nystagmus was recorded until its complete attenuation, while controlling the process on the screen. The coloured progressive matrices by J. Raven were used to estimate an intelligence level of test subjects. The research was carried out with the help of Egoscop software system for objective psychological analysis and testing (MEDICOM-MTD Company, Russia).

There was found a statistically significant correlation between intensity of vestibular dysfunctions in children and results of Raven's Test. The concept *Cognitive Functions* includes spatial awareness and mental object rotation. It is already known that functioning of vestibular system in the inner ear impacts visual spatial skills, spatial memory, ability to perceive 3D space and

spatial navigation skills. These skills are necessary to develop reading and writing. Objective methods of research of vestibular system allow to detect underlying dysfunctions which may be risk-factors for learning difficulties. These kinds of research can be carried out since the first months of life.

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Alternative life stories as a form of integration of past experience in the actual self-concept

Representation of self-concept is regarded as a collection of ideas about self that have a certain consistency. Possible selves are the ideal selves that individuals would like to become, the selves individuals could become, and the selves individuals fear becoming (Markus, Nurius, 1986). The studies of possible selves are mostly focused on the future-oriented time perspective. However, recently has grown the interest to past selves, that continue to influence the person's actual self-concept. These are either past identities that continue to be relevant, or events that have not happened to a person, but he still connects with his self and life: "The Self Not Taken" (Obodaru, 2012), "Forgone, but not Forgotten" (Obodaru, 2016), "The Past is Not Dead" (Eury et al., 2018), "Legends of Myself", "Self-fantasies" (Sapogova, 2003). One of the ways to detect possible selves is a biographical interview, in which they appear as alternative life stories (Avanesyan, 2018). In these stories, a person tells how his life could have been formed if he had made a different choice and the events would have proceeded differently.

Sample: 58 people, 25 men, 33 women aged from 21 to 72 years old, average age of 35.3 years (SD = 11.2, min — 21, max — 72, "sampling whenever possible"). Method: semi-structured biographical interview with categorical analysis of responses.

Result: an empirical classification of 8 types of alternative stories was proposed: 1. A dream to repeat past experience in the present. 2. Regrets of the irrevocably missed opportunity. 3. The story of luck, had it not been, everything would have gone differently. 4. Fantasies about an unfulfilled

dream realization. 5. Choice with unexpected consequences. 6. The path back to yourself. 7. Considering other life alternatives, but not going to change anything. 8. Changing of historical circumstances (nostalgy). It was revealed that the alternative life story was often associated with a crucial event, which violated the continuity and coherence of self-concept (event-change) and reflected the basic values of the individual. Alternative life stories showed that person's comprehension of his life requires retaining at a time (both in one's mental space and in the form of narrative) not only realized, but also unselected or unrealized opportunities.

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Anodal and cathodal tDCS of Wernicke's area affects new word form acquisition: Recognition and lexical decision data

To clarify the role of Wernicke's area in word acquisition, we subjected it to cathodal or anodal tDCS before learning new word forms which were assigned novel abstract or concrete meaning in a short contextual learning session (Shtyrov, 2012; Binde, 2015). To reveal long-lasting effects of tDCS uncontaminated by the online stimulation artifacts, learning outcomes were assessed using lexical decision and recognition tasks 24 hours later, after an overnight consolidation stage.

Existing words in participants' native language (Russian) were modified to create novel items (e.g. personal → *persolat) which were used in a counterbalanced fashion in different roles: as new abstract and concrete words, lexical neighbours/competitors and unrelated fillers. There were 10 sets of stimuli matched on their lemma and final syllable frequency. Participant

acquired the novel forms and meaning by reading (word-by-word) 5 sentences through which the meaning of each word could be discovered.

Three groups (24 native Russian speakers in each, age 17–35) received 15 minutes' cathodal, anodal or sham tDCS over Wernicke's area before the learning session. Accuracy and reaction time (RT) were analysed using Wilcoxon Test (FDR-corrected for multiple comparisons).

The recognition task showed faster responses for new abstract words in the anodal than cathodal group ($p \leq 0.033$). Further, in the lexical decision task, anodal tDCS group had lower accuracy than cathodal and sham groups for existing competitors of concrete words ($p \leq 0.046$), suggesting enhanced competition due to better learning. In both cathodal and anodal groups lexical decision RTs increased for new concrete words in contrast to control non-competitor words (i.e., those that were not used as basis for pseudoword creation; all p-values ≤ 0.05). The findings suggest that both cathodal and anodal stimulation over Wernicke's area can influence integration of novel words into the lexico-semantic system. The effect of cathodal tDCS appears to be limited to novel word forms with concrete meaning, whereas anodal stimulation seems to influence both types of semantics. The results suggest potential applicability of tDCS and contextual learning designs in rehabilitation of speech disorders and learning deficits.

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Attention to different sound features alters the audiovisual correspondence effect

Cross-modal correspondence refers to consistent associations between sensory features from different sensory modalities. For instance, it has

been shown that people associate high pitch or a loud sound with upper space, and low pitch/quiet sound — with lower space (Evans, Treisman, 2010). Although it has been argued that the correspondence takes place in a parallel and automatic fashion (Evans, Treisman, 2010), recent research suggests that the origin of the correspondence effect could be an attentional one (Koelewijn, Bronkhorst, Theeuwes, 2010; Talsma, 2015; Tang, Wu, Shen, 2016).

Our experiment focused on testing this attentional hypothesis by using task-irrelevant visual cues in a sound detection experiment. We increased perceptual auditory load by orthogonal manipulation of loudness and pitch, directing participants' attention to the auditory modality using a sound discrimination task. Two different tasks were used in a fully counterbalanced (within-subject) manner: pitch (1000 vs. 2000 Hz) and loudness (75 vs. 85 dB) discrimination. Although the visual modality was irrelevant to the task, the sounds appeared for 100 ms simultaneously with visually presented dots placed in upper, lower, or central part of a computer screen. Thus, the design was 2 (loudness: loud vs. quiet) x 2 (pitch: high vs. low) x 3 (visual cue location: upper vs. central vs. lower) x 2 (task: pitch vs. loudness discrimination). Fifty volunteers participated in the experiment engaging in 30 trials per condition.

rmANOVA on reaction times showed that auditory-visual correspondence effect was highly dependent on the task. In the pitch task, the facilitatory effect of visual stimulus location on the auditory discrimination was present only for the upper location (but not the lower one) and, crucially, was independent of the concurrent loudness manipulation. Loudness- location effect was not present in any of the tasks, regardless of the attention being focused on loudness or pitch. However, the loudness discrimination task showed an unusual pattern of pitch-location effect: when processing quieter sounds, the low pitch-lower location combination showed faster responses than high pitch-lower location, whereas for the loud sound processing this pattern reversed (low pitch-lower location produced slower responses than high pitch-lower location), with no effects for the upper visual location.

Overall, the results suggest that auditory load influenced the degree and the pattern of cross-modal correspondence, moreover, it showed to be task-sensitive and modulated by the interplay of auditory features. Critically,

this implies that features of the same sensory signals can be interactively and differently combined by our brain depending on the attentional focus.

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Contextual acquisition of novel concrete and abstract words: Dissociation between lexical and semantic levels

Concreteness of words is known to correlate with speed and accuracy of their processing (Fiessbach et al., 2006, Kousta et al., 2011, Barber et al., 2013). Here, we explore this so-called "concreteness effect" in relation to word acquisition process.

Twenty novel word forms controlled for overall psycholinguistic properties were contextually assigned new concrete or abstract meanings, while being visually presented to thirty healthy Russian speakers (16 females, mean age = 23.4±SD4.06) embedded in context of short 5-sentence stories. This contextual learning session was followed by 5 assessment tasks: free recall, recognition, lexical decision, semantic definition and semantic matching.

Statistical analysis using non-parametric Wilcoxon test revealed significant differences between concrete (CW) and abstract (AW) words in terms of the number of correctly reproduced letters of the word form ($p = 0.046$, $M(CW) = 4.30$, $M(AW) = 5.83$), reaction times in recognition ($p = 0.014$, $M(CW) = 879$ ms, $M(AW) = 822$ ms) and lexical decision tasks ($p = 0.028$, $M(CW) = 897$ ms, $M(AW) = 831$ ms). Marginally significant at trend level were differences in the accuracy of definitions ($p = 0.084$, $M(CW) = 10.48$, $M(AW) = 8.60$) and the correctness of their choice from four options (semantic matching; $p = 0.080$, $M(CW) = 5.52$, $M(AW) = 4.83$).

In sum, word concreteness appears to negatively affect contextual acquisition of the corresponding word form (the completeness of its reproduction and the recognition speed), but has a positive effect on the

acquisition of the word semantics. This dissociation could indicate different neurocognitive mechanisms of (a) concrete and abstract word learning and (b) lexical and semantics levels of acquisition, and requires further behavioural and neurophysiological investigations.

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Differential neural basis for different levels of metacognitive evaluations

Metacognitive monitoring is a powerful tool that supports our ongoing cognitive processes (Flavell, 1976). In applied settings, such as when we are trying to learn a new language, monitoring the learning progress may determine the difference between success and failure. One way to measure metacognitive monitoring in relation to learning new material is the so-called Judgments of Learning (JOLs). JOLs are estimations of future success in recalling recently learned information. Depending on the confidence that we have in remembering the new information later, we may decide to keep rehearsing it or just move on. Existing research shows that several variables can mislead our JOLs in relation to the subsequent recall accuracy; at the same time, other variables that influence the recall itself do not affect JOLs. Perceptual fluency, manipulated in different sensory modalities by e.g. font size or presentation volume, leads to differences in JOLs (e.g., higher JOLs for bigger font size), although recall accuracy remains the same regardless of the manipulation. On the other and, the animacy manipulation (e.g., dog vs. table) does not affect JOLs but animate words are remembered better.

Our main aim was to study JOL brain correlates for variables that differently affect JOLs and memory. Participants were presented with words in an easy- or difficult to-read font that referred to animate or inanimate objects while EEG was recorded. For each word, participants had to choose on a 0-100% scale the confidence they had in remembering it in near future.

We found a higher P2 response for high- (70–100%) than to medium-JOLs (40–60%) ratings, which may reflect attentional recruitment resulting in modulation of perceptual processing. Furthermore, we found a greater P600 response for medium- than high-JOLs, suggesting a deeper reanalysis of these type of "less confident" answers. When animacy and perceptual fluency are split between medium and high-JOLs, we found LPC (late positive component) only for animacy, being showing a higher amplitude for the high- than medium-JOLs.. This might indicate a higher involvement of memory processes during the processing of animacy-related information. Finally, when comparing difficult type font words rated with medium and high-JOLs, we obtained larger P3b for high-JOLs rated words, which may attributed to their deeper evaluation. This is the first evidence of differential brain signatures for JOLs depending on their ratings level and different experimental manipulations. Our results highlight the relevance of metacognitive evaluations in the cognitive processing.

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Does the way you feel about humor influence your understanding of comic texts? Evidence from Internet memes

Gelotophobia, gelotophilia, and katagelasticism are the types of attitudes towards humor described by German and Swiss psychologists (Titze, 1996; Ruch, Proyer, 2009). According to recent research, the type

of attitude towards humor correlates with cognitive styles and creativity (Chen, Liu, 2012; Chan et al., 2013). We assumed that the types of attitude towards humor might play a prominent role in understanding humor. This study aimed to test a hypothesis about the correlation between levels of gelotophobia, gelotophilia, and katagelasticism and understanding of Internet memes as a specific form of humor.

Sample consisted of 45 native speakers of Russian (aged 18–30; 73,3 % female). The levels of Internet memes understanding were assessed independently by two experts with the use of criteria formulated during the pilot study based on semi-structured in-depth interviews. Gelotophobia, gelotophilia, and katagelasticism were assessed with PhoPhiKat <30> questionnaire. J. Raven's "Standard Progressive Matrices" test was used to control the level of psychometric intelligence.

We found no correlation between the scores for gelotophobia, gelotophilia, and katagelasticism and understanding of Internet memes. The qualitative content-analysis of interviews' protocols revealed that successful participants with higher levels of Internet memes understanding reflected more on their own thinking process, easily switched from abstract level of reasoning to concrete one and consistently constructed detailed mental representations of the jokes.

Presumably, the type of attitude towards humor does not play a significant role in understanding of comic texts. It is arguable that gelotophobia, gelotophilia, and katagelasticism mediate the perception of comic situations only in a social context, since they are described precisely through social interactions. In addition to this, it can be assumed that general cognitive abilities with a sufficient level of development turn out to be a more significant factor of humor understanding than the emotional attitude to humor. Since our participants had high scores for for psychometric intelligence, we believe that the high level of their general mental abilities led to the mutual independence of the levels of understanding of memes and types of attitude towards humor.

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Does the word have sex? Cognitive processing of grammatical gender by Russian monolinguals and Russian-Turkic bilinguals

Men and women's cognitive processing of words with the different grammatical gender is different. The effect may be caused by several factors: the characteristics of the perception of grammatical markers, the gender opposition as a sociocultural phenomenon. The evidence on the "word masculinity or femininity" has been shown on masculine and feminine grammatical gender. We studied the cognitive processing of words with masculine, feminine and neutral grammatical markers by Russian monolinguals (L1) and Russian-Turkic bilinguals (L2).

In the preliminary study, people distributed the words between the male and female "scope of use". For each of the scope, the most typical words of all grammatical markers were found. In this study, the method of behavioral experiment was used. We included three main groups of independent factors: 1. grammatical markers: male (стол_ — table), female (книг_a — book), neutral (пол_e — field). 2. reference to the respondent's sex by picture priming (male or female) 3. scope of use: masculine or feminine. We measured reaction times in lexical decision task.

1. Russian L1 were significantly faster in word processing than Russian-Turkic bilinguals (Russian L2).
2. Unlike bilinguals, monolinguals processed masculine grammatical gender faster. For bilinguals (Russian L2) factor of grammatical marker was not significant.
3. There was no correlation with picture priming or sphere of usage for Russian L1. However, for bilinguals it was a significant factor (3-way interaction). Inhibitory effect of the sphere of usage and picture priming in the categorization of the words of masculine and neutral grammatical gender was found.

Complex formally semantic structure of Russian grammatical gender was revealed in both grammatical and semantical factors which influenced

cognitive processing of Russian nouns. There was a strong connection between the cognitive category of gender and grammatical gender for Russian L1.

Hypothesis that Turkic mother tongue impacts the grammatical gender processing in Russian was proved. For the bilinguals, the grammatical category of gender was exclusively semantic. The bilinguals (Turkic L1) showed no difference in the processing of the grammatical gender. However, there was an influence of a social and formal factors in the perception of the grammatical gender by bilinguals (e.g. referent relation).

Peculiarities in cognitive processing of neutral grammatical gender were also revealed. Both groups had the same pattern of processing. The reasons of the effect are to be studied.

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Early crosslinguistic effects in bilinguals: Automatic lexical access

Multilingualism is common around the globe: the majority of the world's population is bilingual (Bialystok et al., 2012). One of the most debated questions in the field (see Dunabeitia et al., 2015) is whether two or more languages have separate lexico-semantic storages (Perani et al., 2003; Grosjean, 2014), or a shared storage and activation mechanism (Costa et al., 2008; Van Heuven, Dijkstra, 2010; Kroll et al., 2010). This question can be addressed by using a priming task to examine how primes from L1 influence the processing of target words in L2. The present study investigated the crosslinguistic phonological and semantic similarity effects in late unbalanced bilinguals. Our masked priming paradigm used L1 (Russian) words as primes and L2 (English) words as targets. The primes and targets

either overlapped — phonologically, semantically, both phonologically and semantically — or did not overlap at all. Participants had to maintain the targets in memory and match them against occasionally presented catch stimuli.

Language-related differences in N170 and N400 components were previously reported (Novitskiy et al., 2019); however, recent investigations into L1 processing suggest that lexico-semantic access commences much earlier, around 30–80 ms (Shtyrov et al., 2014; Shtyrov, Lenzen, 2014; Kimppa et al., 2015, 2016), i.e. in the P50 component interval. This raises a question whether L2 lexical access and interaction between L2 and L1 lexicons may also commence at an earlier time. Our analysis of amplitudes in a 40–60 ms post-stimulus time window demonstrated a marginal main effect of semantics ($F = 3.619$, $p = 0.0574$), as well as a reliable interaction between semantic and phonological overlap ($F = 21.093$, $p < 0.0001$).

These findings suggest that lexico-semantic activation of the two lexicons happened as early as 50 ms after word presentation, and a semantic match between prime and target facilitated the perception of the target. We interpret an increased positive peak as an allocation of resources for processing of a meaningful stimulus, as opposed to mismatched stimuli that do not elicit such a peak.

The evidence of early lexico-semantic activation in a masked priming task suggests a high degree of automaticity in lexical access. In fact, if a word in a one language can prime the processing of a word in another one, this supports the notion of a shared storage with common access. We conclude that the semantic and phonological interplay between L1 and L2 suggests an integrated bilingual lexicon.

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Fictional narrative skills in Russian- and Lithuanian-speaking specifically language-impaired children

At the stage of transition from a preschool to school age, children are expected to have mastered sufficient skills for narrative comprehension and production. During school activities, a vast number of fictional narratives are usually employed, and, thus, a child who struggles with narrative comprehension and/or production immediately falls into the at-risk group. Narrative comprehension/production ability requires complex cognitive and linguistic skills (Kornev, Balčiūnienė, 2017) and, thus, even mild intelligence or language impairment might lead to a dramatic decrease in the learning outcomes. The current study aims at the cross-linguistic analysis of narrative structural and linguistic characteristics in Russian- and Lithuanian-speaking preschool age SLI children. Since narrative competence depends not only on language but also on cognitive skills and cultural environment, the cross-linguistic differences might highlight the key measures that should be particularly considered when assessing clinical populations.

For the study, four groups were selected: 1) Russian-speaking SLI children (n = 12), 2) Russian-speaking controls (typically-developing peers, n = 12), 3) Lithuanian-speaking SLI children (n = 12), and 4) Lithuanian-speaking controls (n = 12). During individual assessments, the subjects were asked to tell a story according to a picture sequence. The sessions were audio-recorded and transcribed for an automatized linguistic analysis. Then, individual measures of narrative structural and linguistic characteristics were submitted for statistical comparative analysis.

Russian-speaking SLI and control children were significantly different from the perspective of the MLU rate and the lexical diversity of verbs. Lithuanian-speaking and control children were significantly different from the perspective of only the syntactic complexity. Russian-speaking and Lithuanian-speaking SLI children were similar in all the structural and linguistic parameters, excepting only the syntactic complexity.

Although the study is rather exploratory, the results shed a light on structural and linguistic similarities/differences between narratives of SLI children speaking genetically and typologically close languages but

belonging to different educational systems and cultures. The results of the study will be further discussed in the presentation.

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Iconicity in word processing

This study is devoted to the investigation of the difference in processing of iconic and non-iconic words. The type of iconicity that was studied was onomatopoeia, particularly in lexis, since iconic words have the strongest connection between its form and meaning.

Semiotics as the science of sign systems identifies three types of signs that differ in their degree of motivation: icons, indexes, and symbols. Iconicity is defined as the property of the shape of the sign to correspond to the shape or characteristics of what the sign means. So, for example, Vigliocco (2014) speaks about the existence of differences in the cognitive processing of iconic and non-conic signs using the example of sign language, etc. The language is a sign system. The iconism of a language sign can be traced at various levels of the language system: phonetic iconic character (Coane, 2017) at the phonetic level, the imitation of imitation on the lexical, linear word order on the syntactic, etc.

The method of a behavioral experiment was chosen. The task that was used was lexical decision task. The hypothesis suggested that iconic words would be processed faster than non-iconic ones. This would be explained by the fact that the iconic words require less cognitive effort. Consequently, it would take less time for a person to process an iconic word. The stimuli were 30 iconic words, 30 non-iconic words and 30 pseudowords. All the stimuli were verbs. All groups were divided into 3 subgroups: related to (1) humans (e.g. "чихать"/ "to sneeze"), (2) animals ("мяукать"/ "to meow") or (3) objects ("булькать"/ "to gurgle"). There were 29 participants, of which 23 were female. The participants were shown a word and then were to decide whether it was a word or a non-word. RT was measured.

The result was the following: there was statistical difference in processing of iconic and non-iconic words, however, the non-iconic words were processed faster than onomatopoeic words. This difference, however, was decreased in case of "animal" subgroup.

This effect may have occurred because onomatopoeic words do not have a certain object as a referent, it is a sound instead. Another reason may be that the frequency of the iconic words was not taken into an account. Both of these facts may have lost their effect with the words related to animals (the animal itself may become the referent of the word denoting the sound that it makes).

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Influence of verbal and nonverbal signals on an interlocutor's electroencephalogram

The relevance of the research is in determination of the neural mechanisms of social interaction which is important for understanding the social nature of human behavior. To describe the state of neural networks of the brain of interlocutors in the process of verbal and nonverbal communication — a method of EEG hyperscanning (synchronous EEG recording of the state of neural networks of two brains simultaneously while interaction) was applied.

To distinguish the verbal and non-verbal component during the dialogue an experiment design was developed. It assumed different modes of location of the interlocutors in the same room (face to face, back to back), different modes of communication (silence, monologue and listening, dialogue), different roles of interlocutors (speaking and listening), modes of visual perception (with eyes open, eyes closed).

On the basis of the conducted research it was possible to show that the design structure allowed to establish certain patterns of neural network

reorganization of the brain of interlocutors in the process of dialogue according to EEG data.

It was shown that the total EEG of interlocutors depends on the combination of interaction of verbal and nonverbal components. The highest total EEG capacity of brain activity is shown for the interlocutors' location "face to face" compared to "back to back", in which non-verbal information about the interlocutor was available. All this can be interpreted as an increase in brain activity in case when both types of communication are present: verbal and nonverbal.

When comparing the conversation modes in relation to each other the largest total EEG power appeared in the monologue mode compared to silent, listening and dialogue mode.

During the "silence" mode, a statistically significant difference in power values of mu rhythm between the face-to-face and back-to-back interlocutors was found (in the middle central and parietal areas). Neural networks of mirror neurons during non-verbal communication can be highlighted by the new method.

The direction of verbal communication (speech production or perception) also affects the indicators of human brain activity. These results are interesting to compare with the previous hyperscanning studies that demonstrated the greatest correlation between the nonidentical structures of the speaker's and listener's brain.

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Language processing strategies and hand dominance: How do they really correlate?

The formation of analytical or synthetic /holistic cognitive strategies is often associated with the support of functioning of left or right hemispheres

of the brain. Research task is the identifying the interrelation between cortical organization of motor functions and of analytical and synthetic language processing in SLI preschoolers of analytical cognitive strategy with primary kinetic dysfunction (PKD), and SLI children of synthetic/ holistic strategy with primary somatosensory dysfunction (PSD).

We used longitudinal observations of 1-2 years with neuropsychological testing for identification of the cognitive strategies and their cortex mechanisms; testing of language processing (word differentiation, phonemic analysis/ syllable and phonemic synthesis) and hand dominance in manual praxis with statistical verification (t-test, Pearson correlation coefficient).

For most children, there was a reliable correlation ($p < 0,05$) between success of analytical language processing and preference of not necessarily the right, but the dominant hand. Middle-aged children with PKD revealed a correlation ($p < 0,05$) between performance by subdominant hand and success of analytical processing. There were no stable correlations between success of synthetic language processing and activity of one hand. However, pronounced prevalence ($p < 0,01$) of bimanual reactions in the PSD group was combined with mirror relation between bimanual reactions and success of synthetic processing: there was a positive correlation ($r = 0,52$ ns) in PSD group and negative one ($r = -0,54$ ns) in PKD group.

The analytical strategy is provided by dominant hemisphere, which is not necessarily the left one, but controls the dominant hand. The dominant hemisphere always provides analytical processing, even if it is a right hemisphere in persons with a dominant left hand. Therefore, the dominant hemisphere cannot be synthetic/holistic one.

Specific zones of dominant hemisphere, providing analytical processing, reduce the success of the general biological functions of this hemisphere. Therefore, at the stage of maturation of the analytical zones of the dominant hemisphere, the manual praxis and analytical language processing are better when relying on different hemispheres.

The formation of a synthetic/holistic strategy cannot be due to the support of the functions of one hemisphere, but carriers of synthetic strategy are prone to bimanual responses, probably based on holistic activation of both hemispheres.

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Learning novel written word-forms in native and second-language scripts

Human communication system possesses an impressive ability to efficiently learn and use large vocabularies, both in native and second languages. In visual domain, readers are able to incorporate new word representations into their mental lexicon in a very fast and automatic process, after just few exposures. However, this learning process is still poorly understood in biliterate population, particularly when the orthographic scripts differ between the native and second languages (L1/L2), and, even more crucially, when there is an overlap between scripts, leading to phonetic ambiguities. Since visual word recognition has been found to be affected when graphemes can be translated into different phonemes, the process of novel word learning could be also influenced by the ambiguity of the script. To test this hypothesis, reading latencies were collected from a group of Russian native speakers, biliterates in both Cyrillic and Roman scripts, through a reading-aloud task in which a set of 24 stimuli (12 familiar and 12 novel words) were repeatedly presented across 10 different blocks. A third of stimuli was constructed in L1 Cyrillic script (i.e.: *шаг, шаз*), another third in non-native Roman script (i.e.: *vet, vaz*) and another third in ambiguous script (i.e.: *cop, pex*). Results revealed a significant block×lexicality×script interaction, showing that the decrease in naming latencies across the training differed between scripts in both familiar and novel words. Familiar words showed a larger drop in their RTs when presented in L2 than in L1 script; however, no effect of exposure was found for words in ambiguous script. In contrast, a general RT decrease was found for novel words across task blocks, more expressed for ambiguous and, particularly in L2 script, in comparison to those presented in L1 script. Indeed, differences between novel and familiar words were eliminated at the end of the training in both ambiguous and L2 scripts, but remained in the L1 condition. Moreover, learning outcomes from a posterior recall task also

showed better performance in ambiguous than in L1 and L2 scripts, with no recall differences between novel and familiar words. Overall, our results indicate the acquisition process of mental representations for novel written words is more efficient when graphemes can be decoded into different phonemes. The knowledge of two orthographic systems may contribute to the better learning and recall of the novel word-forms in ambiguous script.

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Novel metaphor production: The effects of meditation

Novel metaphor production is a creative process (Beaty, Silvia, 2013). Cognitive flexibility (CF) predicts creativity on both executive and metacognitive levels (Fröding, Osika, 2015; Hommel, Colzato, 2017). Meditation is a promising tool to enhance cognitive abilities. Notably, Open Monitoring meditation (OMM) supports creativity and CF (Colzato et al., 2017), yet some reviews deem the results of such studies inconclusive (Lippelt et al., 2014). The links between creativity and CF are more established; however, sometimes they are connected indirectly (Nusbaum, Silvia, 2011). We proposed that: 1) OMM improves creativity in novel metaphor production; 2) CF mediates the effect of OMM on creativity.

Participants (n = 55, aged 18–33, M = 20.5) completed several tasks before they were randomly assigned to one of the three groups: OMM, sham-meditation, or control. The first two groups were asked to complete audio-guided mental training tasks (OMM or a narrative on house plants, respectively), and the third had no task. Groups were balanced for sex, age, intellectual abilities, number of days between pre- and post-tests, number of non-missed training days (chi-squared, Kruskal-Wallis, p > .05). Post-test was conducted 13–29 days from the pre-test.

Measures: metaphor production (Bashmakova, Avanesyan, 2016); CF ('Consequences' by Torrance; 'Opposite statements' by Schcherbakova,

Golovanova, 2013); state ('Well-being, activity, mood' by Doskin et al., 1973); sustained attention (Bourdon-Anfimov test); attention shifting (Shulte's tables); intelligence (Raven's Advanced Progressive Matrices).

Hypothesis 1 was not endorsed by the data. No significant intragroup differences were found for metaphors' creativity nor CF in OMM group (Wilcoxon, $p > .05$). Intergroup difference was significant only between OMM and sham group for the post-test metaphor (Kruskal-Wallis, Mann-Whitney, $p < .05$). Further research on the effect of meditation on metaphor production is needed, as there are potential confounding factors: method and its complexity, individual differences, sample size (Davidson, Kaszniak, 2015).

Hypothesis 2 did not receive support as well: CF did not predict metaphors' creativity (Spearman's rho, $p > .05$), thus, we refrained from mediation analysis. Dissonance between convergent and divergent processes at the metacognitive level may be the cause (Hommel, 2012). It would be of interest to employ measures of metacognitive flexibility (Pringle, Sowden, 2017) in future research.

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Predictors of postoperative language outcome in epileptic patients undergoing anterior temporal lobectomy

Anterior temporal lobe resection (ATLR) is an effective treatment for refractory temporal lobe epilepsy. However, it can be associated with language and memory worsening after the surgery, the mechanisms of which are not fully understood (Powell et al., 2008). In this study, we use

comprehensive language battery to analyze pre- and postoperative language status in patients undergoing ATLR. We also investigate whether resection extent, etiology and preoperative language status predict language outcome.

18 patients (age range 20–47, M = 35.4 y.o.) who underwent left ATLR due to refractory left temporal lobe epilepsy were included in the study. 11 of the patients had hippocampal sclerosis (HS). Before and 2–8 days after the surgery all patients were tested with the Russian Aphasia Test (RAT; Ivanova et al. 2016), which assesses both comprehension and production modalities at all levels of linguistic processing. Normalized resection volumes were calculated based on postoperative structural MRI images.

Presurgically, all patients performed relatively well on language tests and, overall showed close to normal language abilities. Some patients had problems with naming and verbal memory as reflected by object naming and sentence repetition tasks. HS was a very strong predictor (p < 0.001) of preoperative language status as revealed by linear regression, with sentence repetition affected the most (by 13.7%). Postsurgically, production but not comprehension was significantly affected (t = 3.4, df = 17, p = 0.003): almost half of the patients decreased their production score by 15% or more. Object naming and sentence repetition tasks were affected the most. Patients without HS had more profound worsening, although the trend did not reach significance. Resection volume and preoperative language status were not predictors of postsurgical language outcome in our sample.

Our results are in line with the previous studies in that the etiology of epilepsy plays an important role in interpreting language and memory deficits in epileptic patients. However, future studies that would include other types of data (e.g., tractography) are needed to pinpoint the predictors of language worsening after ATLR more reliably.

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Prosody and syntax in encoding information structure in Russian: An experimental study

In different languages information structure (IS) is encoded differently: prosodically, with the use of specialized morphemes or syntactically. Russian is a free word order language and also allows phrasal stress shifting. Both word order alternations and stress shifts are used to encode Information structure. Corpus studies on written language show that syntax is the main strategy (Kovtunova, 1975). However, corpus studies on spoken language show that prosody is the main strategy and by altering word order focus often moves to the beginning. So, we conducted experimental study on how these two strategies coexist in speech production and speech comprehension.

We complied 3 experiments, 20 participants in each, all Russian speakers.

Production. We compiled 4 texts in Russian with several dialogues where the question implicates the specific IS in the answer. The answer is missing and the participants are asked to fill the gap using the given words in brackets. They are thus forces to encode the specific IS. After filling the gaps the participants read the texts aloud and recordings are being made. Then we cut out the relevant sentences, we analysed the word order in them and analyzed their prosodic structure using Praat software.

Comprehension. First, we cut out questions and answers read by native speakers and make 24 question-answer pairs. In half of the pairs, the question and the answer are taken from the same dialogue. In the other half, questions and answers are taker from different dialogues, which presupposes different IS. Participants are asked to listen to these pairs and to rate whether they sound naturally or not. Second, we cut out target sentences read by native Russian speakers and ask the participants to listen to them and come up with questions to which these sentences could be used as answers.

The results are the following.

Production:

- Participants prefer the canonical SVO order in 74%, p < 0,01.
- Participants encode IS prosodically (60%) and syntactically (40%), the difference is not significant.
- When altering the word order they move focus both to the beginning (46%) and to the end of the sentence (54%).

Comprehension:

- Participants rate pairs with the same IS higher (4,3) than pairs with different IS (2,1), p < 0,01.
- Participants asked the right questions in 88% cases (p < 0,01), no matter how IS in encoded.
- So, the participants successfully decode IS encoded syntactically and prosodically.

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Quantifications of morphological family size: Evidence from visual lexical decision task in Russian

The morphological structure of a word has been demonstrated to facilitate processing speed (Feldman, Siok, 1999; Bertram, Baayen, Schreuder, 2000; Lüdeling, De Jong, 2002). One measure of morphological structuring is referred to as morphological family size (MFS) defined as the number of different complex words in which a stem appears as a constituent. This co-activation of morphological family members has been shown to be semantic in nature (Schreuder, Baayen, 1997). The effect of MFS has been observed in a number of different languages: English, German, Chinese, Hebrew and Dutch. However, in a morphlogically rich language such as Finnish, the facilitatory effect was only observed when semantically unrelated morphological family members were excluded (Moscoso del

Prado Martín et al., 2004). The present study follows this line of investigation by focusing on the quantification of the semantic structuring of MFS in a morphologically rich language, namely Russian.

We carried out a visual lexical decision task experiment, in which 42 native speakers of Russian participated. The materials of the study consisted of 300 base nouns (Tihonov, 1990) and were scraped from (http://old.kpfu. ru/infres/slovar1/index.htm). To quantify the sematic structuring of MFS, we utilized word embeddings as implemented in the fastText algorithm as this method not only considers word co-occurrences but also letter n-grams (Bojanowski et al., 2017). Previous studies indicate that the inclusion of letter n-gram information also taps into morphological information. We used a publicly available fastText model trained on the Araneum corpus. Pair-wise cosine similarity, ranging from 0 to 1, was used to quantify the semantic similarity between the base and its morphlogical family members, for example the base noun земля "ground/soil" is estimated to be semantically closely related to землица "a piece of soil" (0.8) compared to землеведение "geography" (0.29).

The results of the preliminary analysis offer evidence that the facilitatory effect of MFS on reaction time was only observed when MFS was conditioned on semantic similarity in Russian. Thus, the results indicate that recent advances in word embeddings provide solutions that can be utilized to efficiently model the semantic basis of morphological structuring in language.

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Specificities of brain regions functional connectivity during common-root word derivation task

The specificity of spatial brain potentials organization influenced by grammar processing is still not well understood. Current literature relatively frequently presents the data about alterations in brain activity during the

processing of derivational or inflectional characteristics of words, but a relatively small number of publications are devoted to the brain mechanisms underlying active word-derivation or inflection processes. Therefore, the main attention in this study was given to the analysis of reorganization of the spatial structure for systemic relationships between the bioelectrical activity of different cortical areas during common-root word derivation task (by affixing and composition).

The reorganization of the brain functional connectivity was studied in adults (n = 14) during the test for active mental derivation of common root words. A test word was binaurally presented to a subject through headphones. The subject had to derive mentally as many words with the same root as possible for 1 min.

Cross-correlation and coherent analysis of EEG have shown that the ipsilateral statistical EEG interactions in the left hemisphere, including Broca's and Wernicke's areas, were significantly increased in adults during mental derivation of common root words. Additionally, the decrease of EEG interactions within the right hemisphere and reduced hemispheric EEG relationships were observed. Comparison of our results with the previous data of verbal activity associated with speech perception and production has revealed significant differences in the degree of involvement of the left and right hemisphere cortical activity in verbal processing. For example, unlike the current data, an equal involvement of both hemispheres cortical activity was recorded during the phoneme recognition in auditory perceived words, as well as during the grammar and semantic mistakes recognition in sentences.

Thus, the data obtained in this study indicate the presence of expressed specificities in the lateralization of activity in the neurophysiological mechanisms underlying the processes of active word derivation. The brain mechanisms underlying active word formation processes, i.e. creation of one linguistic units based on other (by affixing and composition) on the morphological language level, apparently, may differ significantly from the central mechanisms underlying speech activities in other language levels.

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Terrifyingly funny: Relationships between gelotophobia and verbal humor understanding in people with various IQ levels

Gelotophobia — a pathological fear of being an object of laughter — was first described in the 1990's by M. Titz (1996). Since then, there have been many studies investigating personal correlates of gelotophobia and characteristics of its manifestation; however, the cognitive side of this phenomenon still remains obscure. We are interested in how gelotophobia mediates cognitive processes — in particular, understanding of verbal comic texts (jokes) that requires the recipient not only to perform formal cognitive operations, but also to develop an emotional contact with the events and characters described in such jokes.

It was previously shown that, in adults with high IQ (112–122 scores on J. Raven' Standard Progressive Matrices test), gelotophobia was negatively associated with a thorough understanding of comic texts (Grabovaya, Shcherbakova, 2017). We assumed that a very high level of IQ may be a compensatory factor and, thus, this correlation might not occur in participants with different IQ levels.

At the first stage of our study, J.Raven' Standard Progressive Matrices test was administered to the participants (N = 69; 45 women; 18–55 years; M = 31.8; SD = 12.6) in order to control their level of intelligence. According to the results, 40 people (25 women; 18–55 years old; M = 34; SD = 11) were invited to participate in the second stage of the study. These subjects were divided into 2 groups (with relatively lower and higher IQ levels) in according to the median (M = 122; SD = 5). Next, the subjects were administered a set of 7 verbal jokes of various levels of complexity (Shcherbakova, 2009) that were a starting point for deep semi-structured interviews. Two independent experts used interview protocols to assess the levels of cognitive and affective understanding of each joke. The level of participants' gelotophobia was assessed using the PhoPhiKat <30> questionnaire (Ivanova et al., 2016).

To test the consistency of the experts' scores, the Kendell coefficient of concordance was used, and the Pearson's correlation coefficient was used to test the main hypothesis.

The magnitude of the correlations between the level of gelotophobia and the levels of understanding of verbal humor did not differ in groups of subjects with different IQ levels. This might be due to the weak manifestation of gelotophobia in the sample and relatively small difference between the levels of intelligence of the subjects from two groups.

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The effect of bilingualism in estimating words emotionality in situation of L2 dominance (Russian-Turkic bilingualism)

The problem of emotional units cognitive processing by monolinguals and bilinguals is actively developed now. The versatility of the problem is explained: 1) by the heterogeneity of the bilingualism concept, 2) by the complexity of the emotionality category. Earlier studies have shown that in general L1 is more emotional than L2 (Dewaele, 2004), but there is a sensitivity dependence on L2 age of acquisition (Altarriba, 2008).

In our work, we deal with a certain class of emotional vocabulary — diminutives, as well as with a special type of bilingualism — Russian-Turkic, the speakers of which are mostly early, natural bilinguals with the L2 (Russian) dominance. The aim of our study is to identify the peculiarities of cognitive processing of diminutives as a special class of emotional vocabulary by Russian-Turkic bilinguals.

We conducted a series of experiments on native Russian speakers and on bilinguals. Firstly, using a questionnaire estimates of 371 words on the parameters: emotionality, AoA, frequency, evaluation, contextual implementation were obtained. Correlation analysis of the parameters was carried out next. Secondly, RT experiment using E-prime software was

conducted. Number of subjects — 46 (23 of each group).Categorization was used as a task. The procedure includes the training session and the experiment. Stimuli — 3000 ms, ITI — 250 ms, fixing cross — 250 ms.

Correlation analysis showed a similar correlation between emotionality and other parameters in two subjects groups: emotion/frequency (r = −0,433067; r = -0,203823), emotion/evaluation (r = −0,520647; r = −0,562701), emotion/contextual implementation (r = −0,467210; r = -0,304490).

The results of the RT experiment showed that both bilinguals and monolinguals have a difference in the perception: diminutives are processed longer than neutral words (p = 0.000). However, in bilinguals this difference is influenced by word frequency and word length.

In our opinion, similar sensitivity to emotionality revealed in two subject groups can be explained by the fact that L2 in the majority was learned at an early age. Such conclusions are consistent with previous observations about the L2 age of acquisition and emotionality perception. However, differences in RT experiments require further research to identify the more precise nature of the emotionality influence.

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The eye movement behavior as the goal-directed activity: Eye tracking study of reading in 9–11 and 12–14 y.o. children

The activity approach (Leontiev, 1975) has wide prospects in the application to the study of the text processing. Eye tracking allows to describe the «actions» expressed in the cognitive and oculomotor strategies of reading (Oganov, Kornev, 2017) and «operations» expressed in the eye movements which are carried out for a text comprehension goal. This

makes it possible to study the cognitive and oculomotor activity of the reader relevant to internal cognitive processing of text and external actions of text analysis.

The aim of study is a psychological and eye-tracking analyses of the 9–11 and 12–14 y.o. children's eye movements in the text reading.

The study involved 49 children of two groups of age: 9-11 (33 children) and 12–14-years (16 children). Eye movements were recorded by using an SMI RED500 eyetracker, while children read two scientific texts. The eye movement fixations and saccades measures were analyzed.

Statistical analysis revealed differences between the groups in the spatio-temporal characteristics of oculomotor behavior. In particular, older child commits less progressive ($p < 0.01$) and regressive ($p < 0.05$) saccades as fixations ($p < 0.01$). Also, we found that elder children used progressive ($p < 0.001$) and regressive saccades ($p < 0.05$) of longer amplitudes. The duration of fixation in the older group was smaller ($p < 0.001$)

The number of saccades and fixations, in particular, reflects to the lower functional level of reading activity and to the number of operations required for the full perception of the graphic space of the text. The differences can be explained by the fact that the task of text perception is more difficult for younger children and the operations of graphic space processing is not mature enough in comparison with older children.

Regressive saccades allow the reader to process the semantic space of the text beyond the word and line and reflect to a higher functional level of text processing strategies. Apparently, older children seem to have more advanced text analysis strategies. Longer amplitudes of progressive saccades in older group can be explained by their ability to anticipate and to analyze more information in a unit of time. This parameter reflects to the cognitive development such as a duration of fixations. Thus, this approach allows us to describe the formation of reading skills and the of low- and high-level actions in the children's reading activity.

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The role of motor system in action-related language comprehension in L1 and L2: An fMRI study

To date, despite extensive research exploring language-motor coupling, the issue that to what extent motor system is engaged in different linguistic circumstances has rarely been discussed. To explore the graded nature of motor engagement, the present study, by adopting fMRI, investigated neural activations of motor and language ROIs in processing languages with different abstraction degree (literal, metaphorical, abstract) in both L1 (native language) and L2 (second language).

L1 Experiment consists of 40 triples of Chinese visual stimuli. Action-related (related to hand or arm) verbs are embedded in both literal (抓住皮球, meaning "catch the ball") and metaphorical phrases (抓住意思, meaning "catch the meaning"). The meaning conveyed by metaphorical phrase is connoted in abstract one (理解意思, meaning "understand the meaning"). Similarly, L2 Experiment includes 40 triples of English verb phrases of three conditions.

Regional effect analysis and PPI analysis were conducted. Results show an attenuated motor activation from literal to metaphorical to abstract language in both L1 and L2, which indicates that motor engagement varies with the degree of language abstractness. Besides, contrast analysis between L1 and L2 shows overall greater activations of motor ROIs in L2, which implies that the degree of motor engagement depends on language proficiency.

Our study is insightful for the understanding of the graded nature of motor system engagement in language processing. Instead of answering YES or NO to the question of whether motor system is engaged or not, our study attempts to answer MORE or LESS to the question that to what extent motor system is engaged in different linguistic circumstances.

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The role of speech characteristics in differential diagnostics of patients with schizophrenia spectrum disorders

One of the main aims of differential diagnostics is to find methods and criteria of predicting development of pathological symptoms of psychotic level. In this regard, speech characteristics can be an important marker, as they might occur before other psychopathological disorders do. The aim of the present study is to reveal such peculiarities of speech which could allow to distinguish patients with schizophrenia and those of high risk of schizophrenia.

Various authors identified different primary components of speech disorders under schizophrenia:

- communicative component (Lebedinsky, 1938)
- tendency to actualize past experience in impressive speech, orientation to acoustic attributes (Kritskaya, 1966)
- subjective meaning of speech (Mikirtumov, Zavitayev, 2012)
- decrease of the ability to reconstruct figurative meaning (Zeigarnik, 1934; Bleicher, Kruk, 1986).

Participants with schizophrenia spectrum disorders: patients with schizoaffective disorder (N = 4) and patients with identified high risk of schizophrenia spectrum disorders (N = 6); controls (N = 9). The groups included only males, age 17–27.

Methods: Kent-Rosanov method of free associations; fables comprehension and scoring (Shcherbakova, Nikiforova, 2016); the text with quasi words "A case with Oliver" (Chernov, 2017) — translation of quasi-words in the text with orientation to the semantic, morphological or phonetic aspects.

Associative test. We suggested that:

1) patients with schizophrenia spectrum disorders will produce more associations based on formal similarities of words, while the controls will operate with more contextual ones (thematic, syntagmatic);

2) patients' associations will be more restricted by subjective context.

Figurative meaning comprehension. We hypothesized a decrease of figurative meaning comprehension in the group of patients compared to the controls. Indeed, patients yielded more low assessments on fables comprehension and less high assessments compared to the healthy subjects, previously studied using the same method (Golshtein, Shcherbakova, 2018).

Quasi words translation. In addition, patients demonstrated primary orientation to morphological and grammatical features (gender, number, case, part of speech) (59,5%) as well as the controls (74,9).

Under schizophrenia spectrum disorders, speech is characterized by the endowment of words with a subjective sense oppressing the semantic meaning; patients with schizophrenia demonstrate reduced comprehension of figurative meaning in impressive speech; no differences between the groups were found for choosing reference properties of words in speech perception.

The results obtained in this pilot study require verification on wider samples.

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Visual object categorization in children with language disorder

The categorization process involves the use of a priori information to speed up the identification of an object. However, the question of the nature of the influence of global and local elements of a priori stimulation on the speed and accuracy of recognition of subsequent information still remains debatable. In order to determine the specificity of the categorization processes it was made the comparison of children with typical language development (30 children), and children with mental retardation and general underdevelopment of speech of four levels:

1–24 children; 2–22 children; 3–22 children; 4–12 children (mean age 6.5±0.4 years).

With the help of priming paradigms, the effect of anticipating visual stimulation on the recognition rate of test objects was investigated depending on the interval between the test and prime stimuli. As test stimuli, figures of animals and drawings of blots of different configurations were used. Combined figures containing test stimuli were presented as prime stimuli, one as a common global image element, the second as an embedded local image element. As a prime stimulus, we used combined figures containing two test stimuli, one as a common global figure element, the second as an embedded local figure element.

The results allowed to establish that in children with typical language development there is a facilitating effect of anticipating global information on the time of identification of visual objects, regardless of the complexity of their categorization. In children with language impairments, analysis of variance showed a significant dependence of the priming effect and the facilitating effect of the time recognition from the level of language development. At the same time, children, whose speech included only simple sentences, narrowed the time window of the facilitating effect. In children who are able to pronounce individual words, a priori information did not affect the speed of identification of drawings of blots. In children with the absence of verbal communication, there was a complete lack of influence of a priori information on the recognition of subsequent information.

The results obtained allow us to state that the categorization processes depends on the type of a priori information, the recognizable object and the level of language development.

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Word lists for speech audiometry in Russian

Speech audiometry is proved to be an efficient method to diagnose hearing disorders. However, its reliability depends to a large extent on the linguistic data, i.e. the stimuli presented to the listeners. The majority of tests for speech audiometry in Russian were developed 30 or more years ago and require revision as they are not always linguistically balanced and include some words that are seldom used in the modern Russian. We introduce a new set of word lists for Russian speech audiometry.

The main linguistic parameters for developing the word lists set were as follows: word frequency (checked in the New Frequency Dictionary of Russian (http://dict.ruslang.ru/freq.php)), phoneme diversity, number of syllables and part-of-speech distribution. In order to provide perceptual balance of the lists we conducted two experiments in which participants with and without hearing disorders (23 and 35 respectively) listened to the pilot versions of the lists and had to repeat the stimuli. As every patient normally has to undergo speech audiometry many times, there should be several lists of different words balanced according to both linguistic and perceptual parameters.

16 word lists were created. Each list consists of 20 frequent Russian words of different parts of speech (9 nouns, 4 verbs, 4 adjectives, and 3 adverbs (or 2 adverbs and a pronoun or a particle in some lists)). In every list, there are 4 monosyllabic words, 9 disyllabic words and 7 words of three or more syllables. All perceptual variants of Russian vowels (depending on the quality of the previous and following consonants) and all Russian consonants are included in every list. We also controlled for the order of stimuli in the lists so that the words of one and the same part of speech and one and the same number of syllables do not immediately follow each other. We also changed the order of stimuli within several lists after the perceptual experiment in order to avoid the morphological or semantic priming effect (when, for example, the word *obschestvo* 'society' was

recognized as *otchestvo* 'patronymic' if there was a word *familiya* 'last name' several words before).

The results allowed us not only to exclude the words that were poorly recognized by participants, but also to compare and to match the perceptual difficulty of different lists. Final versions of word lists are ready to be used in clinical practice.