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Editorial Board: Olga Shcherbakova
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Evgeny Blagoveshchensky
Alexey Filippov

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Keynote presentations

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Dyslexia, Rhythm, Language and the Brain

Prof. Usha Goswami

Centre for Neuroscience in Education
(University of Cambridge, UK)

Recent insights from auditory neuroscience provide a new perspective on how the brain encodes speech. Using these recent insights, I will provide an overview of key factors in children's development of language and phonology, providing a context for exploring atypical development in dyslexia. I will develop an oscillatory "temporal sampling" neural framework for linking rhythmic auditory processing to phonological development by children. I will show that sensitivity to rhythmic structure is key to developing good phonological skills, and that children with dyslexia are relatively insensitive to rhythm. I will argue that rhythmic sensitivity is related to the neural encoding of energy patterns in speech via neuronal oscillatory entrainment.

Goswami, U. (2011). A temporal sampling framework for developmental dyslexia. *Trends in Cognitive Sciences*, 15 (1), 3-10.

Goswami, U. (2015). Sensory theories of developmental dyslexia: Three challenges for research. *Nature Reviews Neuroscience*, 16, 43-54.

Abstract Concepts in Vertical and Horizontal Space: Space-Valence Automaticity and Dynamics

Prof. Armina Janyan

New Bulgarian University (Sofia, Bulgaria)

The conceptual metaphor theory (Lakoff & Johnson, 1980) states that abstract concepts such as Good and Bad are conceptualized through vertical space such that Good is Up and Bad is Down. Conversely, the body-specificity hypothesis proposed by Casasanto (2009) indicates that if people have different bodies and interact with the environment differently, they should also construct different mental representations of abstract concepts such as Good and Bad. Investigations of the body-specificity hypothesis (Casasanto, 2009) focused on handedness, showing that right-handed participants associate good concepts more with their right peripersonal space and bad concepts – with their left peripersonal space. Left-handers exhibited the opposite pattern. My research focuses on the attentional processes the widely used "vertical conceptualization" experimental paradigms require. I argue that exogenous attention may artificially strengthen the observed valence-space association effects. Our recent work controls for exogenous attentional shifts. With regard to the horizontal association, I present evidence that suggests that current motor and spatial experience dramatically changes what was considered "default" conceptualization. In particular, currently experienced motor fluency or experimentally framed motor-spatial context can either eliminate or squeeze the association down to a 2-cm space.

The Role of Prior Knowledge in Acquiring New Semantic Knowledge

Prof. Asaf Gilboa

Rotman Research Institute at Baycrest; Centre for Stroke
Recovery; University of Toronto (Canada)

Cognitive and educational psychology have long identified the influential role of prior knowledge on encoding and retrieval of new knowledge. Two forms of such knowledge have traditionally been the focus of cognitive psychology research: conceptual knowledge and schemas. Cognitive neuroscience has primarily investigated the neural substrates of conceptual knowledge and its influence on new learning, with focus on the anterior temporal lobe (ATL) and related lateral and inferior temporal cortices. More recently schemas have also generated interest in both the animal and human cognitive neuroscience literature. In the talk, data from patients with neurological damage (confabulation and amnesia) and neuroimaging (fMRI and ERPs) will be presented. Neuroanatomically, I will suggest that the same principle of representational hubs that bind together isolated neural modules into multi-modal ensembles operate for different mnemonic reconstructions. The medial temporal lobe (MTL) and hippocampus are a hub for episodic memories, the ATL is a hub for conceptual knowledge, and the ventromedial prefrontal cortex (vmPFC) is a hub for schemas. Facilitation of encoding of new information by prior schemas can be mediated by vmPFC interaction with the hippocampus and posterior neocortex, but the possibility of hippocampal-independent learning under certain conditions will also be explored particularly for linguistic knowledge.

The Contribution of Neurotechnology to the Diagnosis of Language Impairments and the Identification of Language Areas in Individuals with Brain Damage

Prof. Roelien Bastiaanse

Center for Language and Cognition (CLCG)
(University of Groningen, The Netherlands)
Center for Language and Brain
(Higher School of Economics, Moscow, Russian Federation)

Acquired language disorder may be caused by a stroke, traumatic brain injury, a tumor or infections. Depending on the site and size of the lesion, different language levels may be affected: the level of grammar, word selection, phoneme selection and/or articulation may be impaired. For treatment of these disorders (be it speech therapy in stroke patients or surgery in tumor patient), it is important to know exactly which underlying process is impaired. However, in clinical practice not even well-trained speech therapists or clinical linguists have problems to localize the functional language deficit.

The first part of this presentation will be used to demonstrate the course of word production and the deficits that may occur in the stages of this process. It will be shown that the use of EEG may be helpful to identify the locus of the functional deficit.

The second part of the presentation will focus on language mapping with nTMS, that can be used to identify the functional language areas in tumor patients. It will be argued that sophisticated language tests are needed, but also that we are only just beginning to understand how to use this technology for this purpose.

In the final part of my talk I will show that EEG and TMS are complementary and how we can use both devices together to register the process of language production in healthy and language impaired populations. Not only will the merits of neurotechnology be explored, also the pitfalls and the problems to overcome in order to implement EEG and TMS for identifying individual language representation in tumor patients and for diagnosis of the speech and language impairments in stroke patients will be discussed.

The Bilingual Brain: Plasticity and Processing From Cradle to Grave

Prof. Manuel Carreiras

BCBL (Basque Center on Cognition, Brain and Language)
(Donostia-San Sebastián, Spain)
IKERBASQUE, Basque Foundation for Science (Bilbao, Spain)
University of the Basque Country, UPV/EHU (Bilbao, Spain)

Most people either learn more than one language from birth or invest quite a lot of time and effort learning a second language. Bilingualism and second language learning is an interesting case for investigating cognitive and brain plasticity. In this talk (1) I will challenge the “bilingual advantage” and (2) will describe behavioral and neuroimaging evidence on the cognitive and brain mechanisms that adults and infants (monolinguals, bilinguals and second language learners) use for representing and processing languages. In particular, I will address how two languages are represented and activated in the bilingual brain; whether proficient second language learners use similar or different brain mechanisms during processing; and what are the neural consequences (structural and functional) of dealing with two languages in the same or different modalities.

Oral presentations. Day 1

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Modulation of Brain Activity During Selective Attention to Natural Speech

Alina Leminen^{1,2,3}, Maxime Verwoert^{2,4}, Mona Moisala²,
Viljami Salmela², Kimmo Alho^{2,5}

¹ Cognitive Science, Department of Digital Humanities, Helsinki Centre for Digital Humanities (Heldig), University of Helsinki, Helsinki, Finland

² Department of Psychology and Logopedics, Faculty of Medicine, University of Helsinki, Helsinki, Finland

³ Cognitive Brain Research Unit, Department of Psychology and Logopedics, Faculty of Medicine, University of Helsinki, Helsinki, Finland

⁴ Department of Psychology, University of Utrecht, Utrecht, The Netherlands

⁵ Advanced Magnetic Imaging Centre, Aalto NeuroImaging, Aalto University, Espoo, Finland

In real-life noisy situations, such as in a café, we often selectively attend to one speaker in the presence of irrelevant voices. Previous research has shown that both speech and human voice elicit widely distributed activity in the mid superior temporal gyrus and sulcus (STG and STS). The same is true for attention-related modulations of responses to speech sounds. Studies using multimodal speech comprehension paradigm have shown activation of posterior STS and fusiform gyrus for convergence of auditory, visual and linguistic information, while left temporal and frontal cortex underlie successful comprehension. However, neurocognitive mechanisms underlying selective attention in natural conversations, remain unexplored.

In this study, we investigated neural mechanisms of selective attention to natural audiovisual speech by use of functional magnetic resonance imaging (fMRI). More specifically, the participants (healthy adults, N = 15) selectively attended to a video of a conversation between a man and a woman in the presence of irrelevant continuous speech on the background. We modulated the auditory quality of the conversations using noise vocoding and visual quality by masking speech-related facial movements. The participants answered to questions related to the content of the conversations after each line of each dialogue. The participants also performed a control visual attention task that involved focusing on a rotating cross at the center of the screen.

We found that both increased auditory quality and increased visual quality were associated with bilateral activity enhancements in the superior temporal

sulcus (STS). Similar activations occurred, albeit to a smaller extent, in a control visual attention task, suggesting that observed effects are largely stimulus-driven. In addition, decreased auditory quality of attended visual speech led to enhanced right-hemisphere fronto-parietal activity, implying increased need for attentional control. Finally, attention to the audio-visual conversations yielded enhanced activity in multiple brain regions including bilateral areas in the posterior cingulate gyrus, inferior frontal gyrus, temporal pole, and orbitofrontal cortex.

These findings suggest both attentional and social engagement of the participants, since many of the observed regions have been associated with social perception.

Selective Social Context-Dependent Role of the Left Medial Prefrontal Cortex in Communication Exchanges

Beatriz Martín-Luengo¹, Alicia Vorobiova¹, Matteo Feurra¹,
Andriy Myachykov^{1,2}, Yury Shtyrov^{1,3,4}

- ¹ Higher School of Economics,
² Northumbria University
³ Aarhus University
⁴ Saint Petersburg State University

Previous research showed that under uncertainty (when we are not sure about what the correct answer is) in informal contexts such as chatting with friends, we tend to provide any retrieved information indiscriminately. However, in more formal contexts, like a job interview, we apply a more conservative threshold and balance reporting some information while withholding other answers as a way to provide some information while keeping the accuracy high, if possible. The left medial prefrontal cortex (lmpPFC) was suggested as one of the areas linked with self-referential processing in metacognitive decisions.

In the present research, we used repetitive transcranial magnetic stimulation (rTMS) to assess the involvement of the lmpPFC in two different types of social contexts: formal and informal. Three groups of participants were exposed for 15 minutes to an offline 1-Hz rTMS stimulation of either: (1) lmpPFC, (2) control site (rmPFC) or (3) sham (placebo stimulation). Afterwards, participants answered difficult general knowledge questions and rated their confidence in the correctness of their answers. Finally, they decided if they would report or withhold those answers in a formal (job interview) and in informal (chatting with friends) contexts.

There were significantly more reported than withheld answers in the informal context for all three groups. However, in the formal context, there were more withheld than reported answers in the lmpPFC group, with no differences in the other two groups. No differences in confidence ratings between groups were found.

These results suggest a selective involvement of the lmpPFC in self-monitoring in formal contexts; its inhibition seems to highlight the need of accuracy in our answers in a job interview over the socially more acceptable behaviour of always providing an answer when asked.

Supported by the HSE Basic Research Program and the Russian Academic Excellence Project '5-100'.

Combined CIAT-tDCS Therapy in Chronic Post-Stroke Aphasia Improves Neural Speech Processing: Neurophysiological and Behavioral Outcomes

Maxim Ulanov^{1,2}, Yury Shtyrov^{1,3,4}, Olga Dragoy¹, Svetlana Malyutina¹,
Anna Pavlova^{1,5}, Ekaterina Iskra¹, Olga Soloukhina¹, Olga Buivolova¹,
Vidya Somashekarappa¹, Andrey Prokofyev², Matteo Feurra¹,
Friedemann Pulvermüller⁶, Tatiana Stroganova²

- ¹ Higher School of Economics
² Moscow State University of Psychology and Education
³ Saint Petersburg State University
⁴ Aarhus University
⁵ Russian Presidential Academy of National Economy and Public Administration
⁶ Freie Universität Berlin

Intensive speech therapy was shown to lead to plastic changes reflected by lexical mismatch negativity (MMN) responses in aphasic patients (Mohr et al., 2016). Since many studies point to the role of the right hemisphere (RH) in aphasia recovery, non-invasive brain stimulation techniques (TMS, tDCS; Shah et al. 2013) usually target RH to facilitate this process. However, individual variance in stimulation-induced neural changes and resulting therapy outcomes are not understood.

Here, 14 patients with chronic non-fluent mild-to-moderate aphasia caused by a left middle-cerebral artery stroke underwent Intensive Language-Action Therapy (ILAT, Pulvermüller, 2008) combined with anodal tDCS over the left IFG. To assess speech comprehension mechanisms, lexical MMN paradigm (120 deviant words vs. 487 standard pseudowords) was applied in MEG, before and after therapy for patients and once for a group of 10 controls. To improve the SNR of the responses, we applied a noise bootstrapping procedure with individual noise level computation.

We found that the average power of the MMN response in the LH was significantly higher in the patients comparing to the healthy controls ($p=0.01$). Moreover, the variance of the MMN power increased significantly in the patient group after the treatment. This increase correlated with the behavioural improvements measured as a change of accuracy in a verb generation task ($p=0.002$). These changes were also associated with clinical improvements in speech comprehension measured by Russian Aphasia Test: scores in a sentence repetition subtest significantly increased after therapy ($p = 0.035$). No effects were found for the RH. Our results point to the compensatory role of the left hemisphere in the chronic stage of aphasia. They also highlight the role of individual variability in recovery of the language function, suggesting considerable individual differences in the recovery potential. The study continues to investigate these effects in larger samples.

Online Formation of Memory Traces for Novel Morphology

Viktória Balla¹, Yury Shtyrov^{1,2,3,4}, Miika Leminen¹, Alina Leminen¹

¹ University of Helsinki

² Higher School of Economics

³ Aarhus University

⁴ Saint Petersburg State University

For the fluent use of most languages, learning to recognize morphemic boundaries is crucial. The question of morphological learning is especially relevant in languages with very rich morphology like Finnish. Recent neurocognitive studies propose separate systems for decomposition and storage, which are flexibly used during the processing of polymorphemic inflections and derivations. Nevertheless, neural correlates of acquisition of novel morphology remains largely unexplored.

To address this question, we trained 19 healthy native Finnish speaking participants with new derivational suffixes through a word-picture association task. The short training session was followed by a subsequent 20-minute magnetoencephalography (MEG) recording, where the participants passively listened to trained and untrained suffixes combined with real and pseudoword stems. To assess the rapid online learning of novel suffixes, we compared event related field responses (ERFs) recorded in the first and last 4 minutes of the passive listening task for both previously trained and untrained suffixes.

We found a response increase in the left frontal and temporal sensors for the semantically trained suffixes compared with the untrained ones at 50-70 ms and 120-140 ms time-windows after the suffix onset. This response increase suggests that even a short training of novel affixes can facilitate morphological decomposition and speed up the suffix memory trace formation. At the same time, we found a response decrease for the novel suffixes combined with pseudoword stems, which might reflect facilitated decomposition to the newly trained suffixes and novel stems towards the end of the experiment.

Overall, our findings suggest immediate formation of memory representations for novel affixes, with a facilitative effect of semantic training on morphological parsing.

Acquisition of New Word Meaning. MEG Study

Alexandra Razorenova¹, Boris Chernyshev^{1,2}, Anastasia Nikolaeva³,
Andrey Prokofyev³, Nikita Tyulenev¹, Tatiana Stroganova³

¹ Higher School of Economic

² Moscow State University

³ Moscow State University of Psychology and Education

The question which is crucial for understanding neurophysiology of language is how our brain transforms sensory-motor experience to get word semantics. Vocabulary of any human language exceeds any size limits estimated in terms of modern theories of memory and learning that challenges science to describe speech semantic mechanisms within human brain. Multiple research works support the embodied cognition theory. Associative learning paradigm implies that the word meaning encoding is implemented in the brain via Hebbian-type learning. We developed an auditory-motor experimental procedure that allowed investigating neural underpinning of word meaning acquisition by way of “trial-and-error” learning that mimics basic aspects of natural language learning.

Participants were presented with eight pseudowords; four of them were assigned to specific body part movements during learning blocks – through commencing actions by one of participant’s extremities and receiving a feedback. The other pseudowords were used as controls. MEG was recorded during passive listening of the pseudowords before and after learning. Correlation between the brain activity and the learning rate in participants proves that the effect observed is relevant to formation of a memory trace linking the acoustic pseudowords to their meaning. A significant effect was found in the parabelt areas responsible for spectrotemporal analysis and the initial steps of word recognition (middle part of the STG). Also, activation of the posterior opercular part of the IFG was observed, supposed to reflect subvocal rehearsal and articulatory coding of the perceived speech sounds. Both effects appeared within the left hemisphere only. We observed that the new-word-pseudoword differential brain activity occurs at least 250 ms after disambiguation point. The spatial-temporal pattern of a new-word effect indicates that the neural processes engaged in learning the unknown word differ from those involved in the decoding of well-known word semantics.

Taken together, our findings imply that long-term effects of natural language usage may involve multiple consolidation phases; rooting the word meaning into one’s sensory-motor experience is a necessary but not a sufficient prerequisite for its embedding into the associative structure of semantic memory.

Supported by Russian Foundation for Basic Research grant 17-29-02168.

FMRI Study of Brain Function Organization of Text Processing in Adolescents and Young Adults

Natalia V. Shemyakina^{1,2}, Zhanna V. Nagornova^{1,2}, Vadim A. Novikov¹,
Elizaveta I. Galperina^{1,2}, Alexander V. Pozdnjakov¹, Alexander N. Kornev¹

¹ Saint Petersburg State Pediatric Medical University

² Sechenov Institute of Evolutionary Physiology and Biochemistry
of RAS

The text processing is a multilevel activity affected by various in- and extrinsic factors. The fMRI study aimed to compare text processing between adults (27 persons, mean age 19.5 ± 0.8 [SD]) and adolescents (12 persons, 11-14 y.o.). The group of adults was divided into 2 subgroups: “good” (G) and “poor” (P) written texts’ comprehenders. We hypothesized that the brain activations related to the text processing in adolescents might be similar to that of less skilled adult comprehenders.

The entire brain BOLD signal analysis, comparing reading tasks (words (W), nonwords (NW), sentences (S), texts (T)) for adolescents vs. adults was applied, using two-sample T-test with $p < 0.001$, FWE corrected.

There were no higher BOLD level activations revealed for children in comparison with adults. “G” demonstrated more activations in MTG (BA37/21) and MTG/AG (BA39) of the right hemisphere while sentence and words reading, correspondingly; and in the left occipital cortex while words’ reading in comparison with adolescents. “P” group demonstrated an increased BOLD signal in MTG, occipital areas bilaterally for words reading and more activated areas of the right temporal cortex during NW task in comparison with adolescents. Good comprehenders had more spread activations in occipital and temporal cortex. The behavioral data revealed longer RT times(ms) in children while reading tasks fulfillment: (W: 965 ± 249 , 693 ± 139 & 624 ± 94 ; S: 2123 ± 534 , 1463 ± 194 , 1237 ± 167 ; NW: 1055 ± 393 , 763 ± 171 & 637 ± 109 in adolescents, “P” and “G” correspondingly. “P” adults read significantly less number of items in self-paced mode and demonstrated less percent of correct answers vs. “G” in sentence reading task.

Behavioral results together with related temporal and occipital cortex activations for adults in comparison with adolescents support the idea that neural mechanisms of text processing might be related to both age and comprehension skills level.

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Oral presentations. Day 2

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Differential P300 and N400 Modulations During the Semantic Training of New Words Under Reading and Lexical Decision Tasks

Beatriz Bermúdez-Margaretto¹, David Beltrán²,
Fernando Cuetos³, Alberto Domínguez⁴

¹ National Research University – Higher School of Economics, Institute for Cognitive Neuroscience – Centre for Cognition & Decision Making

² Instituto Universitario de Neurociencia (IUNE), Universidad de La Laguna, Spain; Facultad de Ciencias de la Salud, Sección de Psicología, Universidad de La Laguna, Spain

³ Facultad de Psicología, Universidad de Oviedo, Spain

⁴ Instituto Universitario de Neurociencia (IUNE), Universidad de La Laguna, Spain; Facultad de Ciencias de la Salud, Sección de Psicología, Universidad de La Laguna, Spain

Differences between lexical decision and reading tasks in the activation of semantic processing have been a central question in psycholinguistic research. Lexical decision is considered more dependent on word meaning, whereas reading has been found more sensitive to phonological rather than to semantic processes (Yap & Balota, 2009; Katz et al., 2012). This study aimed to test the involvement of semantic processing during reading and determine whether the higher semantic deepness attributed to lexical decision could be consequence of a higher categorization demand.

EEG signals were recorded during lexical decision (n=22) and reading (n=25) tasks with the same set of words and pseudowords presented in association with a picture during six blocks. N400 and P300 components were examined as markers of semantic and categorization processing.

rmANOVAs revealed that N400 lexicality effect was eliminated at reading after semantic training but remained significant at lexical decision, despite the stronger N400 reduction found for pseudowords across this task. However, the P300 block effect found for words within N400 time window contributed to maintain differences between both types of stimuli at the lexical decision task. Interestingly, no P300 modulation was exhibited by words at the reading task, where no stimuli categorization was required.

Reading showed a clear influence of semantic information during the training. However, results in lexical decision were confounded by the co-occurrence of both ERP components, with the N400 stronger reduction for pseudowords resulted from the simultaneous N400 reduction (due to semantic association) and P300

increase (due to stimuli predictability in relation to the task strategy). Therefore, the higher recruitment of semantic processing found at lexical decision was in fact increased by stimuli categorization, with both associative and predictive processes overlapped during this task.

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Spatiotemporal Dynamics of Processing Target Information Among Familiar and Unfamiliar Written Words

Anna Rebreikina

Institute of Higher Nervous Activity
and Neurophysiology of RAS

In modern day-to-day life, we need to select important information from the flow of news, advertising, messages and so on. In the present study, we investigated ERPs and the oscillatory neuronal dynamics of EEG to explore the spatiotemporal dynamics of processing target information among familiar and unfamiliar written words.

Sixty subjects (aged 19 ± 2) provided written informed consent and took part in the experiment. EEG was recorded from 28 electrodes, while subjects had to decide whether visually presented familiar and unfamiliar words belong to a given category or not. The N170, N400 and the late positive component (LPC or P600) amplitude were analyzed. ERD/ERS responses were examined in 3 EEG frequency bands of interest: 1-4, 4-8, 8-12 Hz. Theta and alpha ERS/ERD were analyzed in the interval from 100 to 350 ms after stimulus presentation, delta ERS/ERD was analyzed in the time interval 400-700ms.

The N170 to target words was larger in the posterior sites than that to non-target and unfamiliar ones. N400 to unfamiliar and non-target words was more negative in the frontal, central and parietal areas. That is, the so-called N400 priming effect was observed. LPC was larger in response to target than to unfamiliar words over all scalp sites, and it was larger to target than for non-target words in the central, parietal, occipital and parietal-temporal sites. Theta ERS in response to unfamiliar words was smaller than to the familiar words, both target and non-target, over occipital brain regions. Also, theta ERS in response to non-target words was reduced compared to target ones in the left posterior-temporal sites. Delta ERS in response to unfamiliar words was reduced than to the familiar words over the all of brain areas.

Thus, the target words are associated with larger theta ERS and N170 at the early stage after stimuli onset (150-300ms). These effects can be related to the top-down modulation of visual processing and selective attention. Unfamiliar words are characterized by reduced delta band synchronization; this can be related to failure in search of appropriate engram in memory storage. The observed late positive component effect can be related to the decision making, including the integration of retrieved memory signals with task-specific processing.

Behavioural and ERP-Correlates of Explicit and Implicit Acquisition of Novel Words

Olga Shcherbakova¹, Alexander Kirsanov¹, Elizaveta Nikiforova¹, Margarita Filippova¹, Evgeny Blagoveshchensky^{1,2}, Yury Shtyrov^{1,2,3}

¹ Saint Petersburg State University

² Higher School of Economics

³ Aarhus University

It has been suggested that two main learning strategies known to be involved in word acquisition (implicitly through context, a.k.a. “fast mapping”, FM, and explicit encoding through direct instruction, EE) differ in terms of their brain bases, but neural correlates of these learning types remain elusive (cf. Greve et al. 2014; Merhav et al. 2015). We compared event-related potentials elicited in the brain of adult volunteers learning new wordforms in either FM or EE fashion, with the two tasks being matched for their auditory and visual features, and the manner of presentation.

We designed a set of audio-visual stimuli that combined images of one familiar and one novel object with auditorily presented questions. Under the FM condition, the meaning of a new wordform could be inferred from the context. Under the EE condition, the novel image and the wordform corresponded explicitly; the task was to learn this correspondence. All wordforms were balanced for length, bigram and diphone frequency and counterbalanced across experimental conditions. Ten novel words were presented in each condition to 12 healthy right-handed Russian-speaking volunteers; as a control condition, familiar words and images were used. All conditions were pseudo-randomised in a single sequence. We recorded ERPs elicited by passive listening of wordforms and compared them before and after the training session.

Behavioral results showed no significant differences between successful learning of new wordforms in both FM and EE conditions. Auditory ERPs peaked at ~170, 250 and 520 ms. All three peaks indicated clear learning effects, with ERPs elicited by familiar and novel wordforms diverging before training but becoming highly similar following the learning session. The topography of ERPs effects differed significantly between the FM and EE conditions in the early negativity arising at ~170 ms. For wordforms presented under EE condition, this topography displayed right-lateralised changes, whereas for those presented in the FM condition, learning-related dynamics was distributed more centrally/left-lateralised. Analysis of cortical activity sources using LORETA suggested that the learning dynamics was underpinned by differentially lateralised activity in anterior temporal lobes of the two hemispheres as well as parietal and frontal areas. The results support the existence of two different neural learning mechanisms for word acquisition and suggest their differential distribution across the two cerebral hemispheres.

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Cognitive and Affective Components of Verbal Humor Comprehension in Healthy People and Psychiatric Patients

Olga Shcherbakova¹, Viktoria Obraztsova^{2,3},
Ekaterina Grabovaya⁴, Russell W. Chan^{5,6}, Alyona Ivanova^{2,7}

¹ Saint Petersburg State University

² Mental Health Research Center

³ Federal Scientific Clinical Center of Reanimatology and Rehabilitation

⁴ PJSC "B&N Bank"

⁵ University of South Australia

⁶ Higher School of Economics

⁷ Pirogov Russian National Research Medical University

Humor comprehension is an important cognitive and linguistic skill. It plays a crucial role in our social well-being and is known to be affected by psychiatric diseases.

We compared the quality of verbal humor comprehension in healthy people (N=39) and patients with schizophrenia and schizotypal disorders (N=19) and affective disorders (N=12). We predicted that in psychiatric patients compared to healthy controls 1) the quality of humor comprehension is lower; 2) the correlation between cognitive and affective components of humor comprehension is lower. A set of 7 verbal jokes was administered to the participants individually and followed by in-depth semi-structured interview that aimed to reveal the levels of cognitive (CHC) and affective humor comprehension (AHC) of each joke. The transcribed protocols of the interviews were assessed independently by 4 psychologists, 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 distribution of scores for various levels of CHC and AHC in healthy people revealed that low levels of CHC (1 and 2) were 0-11,5% and high levels of CHC (4 and 5) were 20,5-59%. In psychiatric patients, the ranges were 3,2-38,7% and 6,4-32,3%, respectively. In healthy people, low AHC (1) was observed in 27,7-36,5% of cases, and high AHC (3) – in 28,8-48,4% of cases. In psychiatric patients, low AHC was 42-93,5% and high AHC was 0-9,6% of cases. The results showed that the quality of verbal humor comprehension was higher in healthy people compared to psychiatric patients. This finding is consistent with our prediction and in line with other studies (Polimeni et al., 2010). Interestingly, healthy people also exhibit difficulties with understanding

jokes' meanings, and partial comprehension was common for this population. Pearson's rho revealed a positive correlation (p<0,001) between CHC and AHC in both healthy (r=0,696) and clinical (r=0,573) groups; however, in the clinical group this correlation was lower, which corresponds to our prediction.

We suggest that, in psychiatric patients, cognitive and affective components of thinking and comprehension are less integrated compared to healthy controls. Lastly, in mental patients, unlike healthy people, these components might be mutually decompensating.

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Effects of Wernicke's Area tDCS on Acquisition of Novel Semantics

Evgenii Blagoveschenskii^{1,2}, Diana Kurmakaeva¹, Nadezhda Mkrtychian¹,
Daria Gnedykh¹, Svetlana Kostromina¹, Yury Shtyrov^{1,2,3}

¹ Saint Petersburg State University

² Higher School of Economics

³ Aarhus University

Concrete and abstract semantics are assumed to be underpinned by partly different brain systems. However, neurophysiological mechanisms of acquisition of novel concrete and abstract semantics remain unstudied. Our aim was to investigate putative role of one of the core language areas in this process.

48 monolingual Russian-speakers were divided into cathodal and sham (placebo) tDCS groups. An active cathodal electrode was applied over Wernicke's area (CP5 scalp location, 10/20 EEG system) for 15 minutes. After real/sham stimulation both groups underwent a learning session, in which participants were presented with previously unfamiliar word forms with novel meanings. They had to discover the meaning of 10 concrete and 10 abstract novel words from blocks of 5 context sentences, balanced for length and number of words. Novel word forms were created based on existing words of the participants' native language by transposing the ultimate syllables. For novel concrete semantics rare and obsolete objects were used, whereas novel abstract semantics was borrowed from foreign cultures. Acquisition of novel semantics was assessed immediately after the learning session and on the next day in order to check consolidation effects, using a free-form definition task. Participants had to match the novel word with its meaning (semantic matching) and describe the meaning of the new concept in their own terms (definition accuracy).

Results showed successful acquisition of both types of semantics, which, however, differed between groups. In the sham group, semantic matching performance decreased on Day 2 for abstract concepts, whereas in the cathodal group, it decreased on Day 2 only for concrete concepts. In the cathodal group a better definition accuracy on Day 1 was revealed for concrete concepts as opposed to the abstract ones. A comparison between stimulation conditions revealed overall better performance of the cathodal group for the novel abstract semantics on the Day 2.

The results indicate rapid efficient systems for contextual acquisition of concrete and abstract semantics, and a more prominent role of Wernicke's area in consolidation of novel abstract semantics.

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Gaming in Children's Foreign-Language Learning

Sari Ylinen¹, Katja Junttila¹, Anna-Riikka Smolander¹, Maria Uther², Reima Karhila³,
Seppo Enarvi³, Kalle Palomäki³, Mikko Kurimo³, Risto Näätänen¹

¹ University of Helsinki

² University of Winchester

³ Aalto University

Language and communication skills will be increasingly important. Future learning will likely be assisted by technology, and initiatives to improve foreign-language skills and to stimulate learning and teaching through ICT and digital content are needed. Digital learning environments using the gaming approach have great potential especially in children's foreign-language learning which requires extensive training.

We have designed a digital game Say it again, kid! that aims to support children's learning of spoken foreign language. Children are stimulated to speak English and advanced speech technology is used to assess their utterances. This automatized assessment enables the game to reinforce learning by providing feedback. We sought to investigate the effect of gaming approach in children's foreign-language learning. The learning effects of the game were evaluated by measuring the mismatch negativity (MMN) component of event-related potential (ERP). 37 typical readers and 24 children with dyslexia (7-11-year-old) trained with the game for about 5 weeks (4-5 days per week, 15-20 minutes per day) and participated in EEG measurements before (pre-test) and after (post-test) the gaming period. To reveal the effect of gaming, learning was compared in two conditions: a game condition with game boards that the children could freely explore a non-game condition with white screen and forced presentation of English words. In the game condition, feedback (1-5 stars) was used as a game element (the stars enabled to proceed on the game board), whereas non-game condition provided no feedback. To control for the effect of exposure on learning, the number of English words presented in each condition was the same.

In typical readers, the MMN responses were significantly larger in the post-test than in the pre-test in the gaming condition, but not after using the non-game, suggesting that gaming induced more robust plastic changes in the brain. However, children with dyslexia did not show increased MMN after gaming. Thus, they do not seem to benefit from gaming similarly to typical readers. Since striatum as part of the reward system of the brain has been suggested to be abnormal in children with language disorders, a possible account for seeing gaming effects in typical readers but not in children with dyslexia is differences in the activation of striatum. The findings are applicable to language teaching and the development of language-learning applications for children.

“The First Name is Agent” in Primary School: Phenomenology and Neuropsychological Analysis

Tatiana Akhutina¹, Alexey Korneev¹, Ekaterina Matveeva¹,
Yana Panikratova¹, Roza Vlasova¹

¹ Moscow State University

Aphasia patients and 4-year-old children understand passive structures with reverse word order better than that with direct order. It was explained by the word order strategy with the rule “The first name is Agent”. It was assumed that the right hemisphere functions participate in processing this rule. In our study, we investigated whether a strategy based on word order is used in understanding of grammatical structures by primary schoolchildren.

We used: (1) computer-based sentence-to-picture test of understanding reversible grammatical constructions (GCs): active direct (AD), active reverse (AR), passive direct (PD) and passive reverse (PR); (2) neuropsychological assessment adapted for children (Akhutina et al., 2016). 93 first-graders, 93 second-graders and 63 third-graders participated in the study.

In order to divide children into groups that differ in the productivity of understanding of the four types of GCs k-means clustering was used. 4 clusters were extracted. In cluster 1 there were a small number of children with low productivity (6, 0 and 2 children), they were excluded from further analysis. Cluster 2 included children with greater productivity in understanding PR structures than PD (group 1) and cluster 3, with a better understanding of PD structures (group 2). Cluster 4 included the most successful children with a good understanding of passive structures (group 3).

The distribution of children by group in grades was as follows: 26, 31, 43% (grade 1), 19, 24, 57% (grade 2), 20, 21, 59% (grade 3). Analysis of the response time to different GCs in children of the three groups showed significant differences in all grades. The increase in time in group 1 in the grade 1 occurred in the order AD<PR<AR<PD, in the grades 2 and 3 – AD<AR<PR<PD. The difference in RT between AD and PR in grade 1 was minimal, but it noticeably increased in grades 2 and 3. The same order of AD-AR-PR-PD was observed in group 3, but only in grade 1. In all other cases PD preceded PR.

Neuropsychological analysis showed the lowest rates of group 1 in all grades. It is noteworthy that the index of right hemisphere functions in group 1 was not significantly different from group 2 and group 3 in grade 1, but not in grades 2 and 3.

Thus, our data suggest that the best processing of PR structures in grade 1 and in classes 2-3 has to be explained by different mechanisms.

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Poster presentations. Day 1



A Neurolinguistic Approach to the Study of Oral Discourse Structure

Mariya Nagornaya¹, Olga Ivanova¹, Angelina Kudryavtseva¹

¹ Moscow State University

Oral discourse can be divided into separate events of different levels (that is, elementary events, groups of events, complex episodes). The process of oral speech production and perception is always followed by unconscious separation of mental images into such components, with no set correct way to divide these information units into smaller parts (Chafe, 1990). In our research we applied the method of ultrafast fMRI in order to find neural correlates of discourse structure, i.e. whether there are significant brain activity changes on the event boundaries.

This method has been used in (Zacks et al. 2001) where the participants were shown some short videos during the fMRI-procedure. The first group was asked to press the button when they thought the new event started, the second one was just watching the video. They found significant peaks of activity which, however, were expressed more clearly among the first group, so, as the authors themselves admit, it is hard to make an evident conclusion, particularly some of these brain areas are functionally related to such parameters as concentration and solving problems. The main difference between this work and our experiment is that we consider the process of perception as unconscious one. Another difference is that we consider both discourse production and discourse perception.

In our study, we used “The Pear Stories” by W. Chafe (Chafe, 1980) as the experimental material. We invited 20 young people for the fMRI-experiment and asked them to watch this film during the procedure and then to retell the plot. In advance we singled out 28 main events of the film. In each of the retellings we also selected the statements corresponding to the events from the list. The data were analyzed using SPM.

Individual analysis showed multiple significant activity changes on the selected event boundaries. In particular, we observed the peaks of activity in the middle temporal visual area (V5), which also plays a major role in the perception of motion and the integration of local motion signals into global percepts (Born, Bradley, 2005) and which also showed significant activation peaks in (Zacks et al. 2001). We present the most significant correlations, discuss the advantages and disadvantages of our method and offer suggestions for its improvements.

A Psycholinguistic Study of Semantics in Terms of Speech Recognition: Evidence from Russian Language

Olga Pilatova¹, Elena Riekhakaynen¹

¹ Saint Petersburg State University

The goal of the study is to explore what kind of semantic information a listener can use while processing speech. To answer this question, we started by determining semantic features of nouns that a native speaker of Russian has in his/her mental lexicon. Native Russian speakers (43 m. & 47 f.) wrote down essential semantic features of each of 10 concepts expressed by Russian nouns: *sobaka* (dog), *rubashka* (shirt), *kniga* (book), etc., according to the task proposed by McRae et. al. (2005). Words sharing the same stems in the answers of different participants were grouped together even if they expressed different ideas as a whole (*oshibka prirody* ‘freak of nature’ vs. *tsar’ prirody* ‘the king of nature’) or pointed at different semantic roles of the concept (*smejotsa* ‘is laughing’ vs. *smeshnoy* ‘funny’). Then, the answers for each concept were ranked by frequency. Participants tended to mention as essential the same features and to use the same words for them. We also observed a tendency for one verbal representation of a feature to be chosen by participants more often than the other(s), if there were several possible ways to express similar meanings, e.g. *layat’* (44 answers) vs. *gavkat’* (9) for ‘to bark’. Parts of speech in the answers and their grammatical forms were likely to depend on the strategy a participant had chosen for the description: for example, via initial forms of words, via adjectives and so on.

A corpus-based study (using the Corpus of Spoken Russian: <http://ruscorpora.ru/search-spoken.html>) showed that the majority of the words proposed by the participants are present in the nearest contexts (\approx +/- 20 words) of the target words. The words of the same root grouped together describe the concepts which constitute the basis of the conventional framework of the mental lexicon of a speaker and a listener. Although not all of the obtained features are necessary and sufficient from the logical analysis approach, their combinations are likely to be used for the prediction of words during speech recognition. This assumption will be verified in a future study, to find out if it is possible to obtain semantic representations of words automatically from their context and to use them for speech processing simulation.

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An Eye-Tracking Study of Processing Sketches: Evidence from Russian

Tatiana Petrova¹, Valentina Bratash¹, Elizaveta Zhukatinskaya²,
Anastasiya Salnikova², Anastasiya Suhareva², Ekaterina Zhelezova²

¹ Saint Petersburg State University

² Sirius Educational Centre, Sochi, Russia

As visual representation of information is getting more and more popular nowadays, studies of so called “creolized” texts integrating both verbal and non-verbal types of information are of high priority (Chernigovskaya et al., 2016, Petrova & Riekhakaynen, 2018). Sketchnoting is a perfect example of a creolized text, in which drawings or visual representations of complex information are aimed to make comprehension easier. Nevertheless, no experimental evidence has been provided so far concerning sketches as an educational material.

This study was aimed at revealing specific features of verbal text and sketch perception and assessing sketchnoting efficiency. Our hypothesis was that readers process different formats of texts differently, sketches being easier to process and understand than a verbal text of the same content. To examine this issue, 20 Russian-speaking high school students (Sirius Educational Centre, Sochi) were involved in the experiment. Four texts about biographies of Russian poets were converted into different sketches of three typical formats: linear, trajectory and radial. During the eye-tracking experiment, the participants were asked to learn 4 stimuli: 3 sketches and 1 classical text on different biographies. We measured the total dwell time, the total fixation count, average fixation duration for each verbal and non-verbal zone of the texts, for horizontal and diagonal zones. The comprehension was controlled by question-answer method, key words method, and scaling method, when they had to evaluate the level of difficulty while reading.

The outcome has shown that a sketch in any format is read significantly faster and better than the text of the same content. The analysis of participants’ eye movements while reading the stimuli made it possible to propose a number of recommendations for creating sketches: (1.) It is better to separate areas of interest from each other; (2.) It is not necessary to use a diagonal position of the text because such zones are read significantly slower; (3.) It is better to control the reader’s attention with arrows/pointers as they help to learn the text faster. The best format of sketches is of the trajectory type; (4.) It is important to duplicate the information from the title because readers do not pay much attention to it; (5.) It is really helpful to back information with illustrations (e.g. to draw the portrait of the main character, if it is a biography).

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Analysis of Discourse Macrostructure in Schizophrenia: A Corpus Study

Galina Ryazanskaya¹, Mariya Khudyakova¹

¹ Higher School of Economics, Moscow, Russia

Schizophrenia is a mental disorder characterized by disintegration of thought and perception, loss of contact with reality, and weakened emotional responsiveness. One of the diagnostic criteria for schizophrenia both in DSM-5 and ICD-10 is disorganized, bizarre speech. However, there is no universal way to define and measure speech incoherence in schizophrenia. We applied measures of coherence and information completeness, previously developed for study of speech by people with aphasia, to narratives by people with schizophrenia.

The Russian CliPS is a corpus of the Pear film retellings (Chafe, 1980) by people with aphasia, right hemisphere damage, and neurologically healthy speakers (Khudyakova et al., 2016). For the current study, we have analyzed 10 narratives by neurologically healthy speakers and 9 narratives by people with schizophrenia recruited in a day hospital department of a psychiatric clinic. Narratives were scored on a 5-point scale for local and global coherence (Davis and Coelho, 2004), a common approach to analyzing discourse coherence in clinical populations. Every elementary discourse unit is assigned a score from 1 to 5 based on its relation to the topic of the story (global coherence) or the previous unit (local coherence), and the average score on each measure is calculated. We also measured the number of violations of completeness, that is, crucial episodes from the Pear film missing from a narrative (Christiansen, 1995).

The results are summarized in Table 1. No significant difference was found between the groups in any measures: global coherence, local coherence, or number of violations of completeness per utterance.

Table 1. Scores on global and local coherence, and violations of completeness

Measure	Healthy speakers		Speakers with schizophrenia	
	Mean	SD	Mean	SD
Global coherence	4,39	0,39	4,10	0,53
Local Coherence	3,78	0,26	3,45	0,44
Violations of completeness per utterance	0,02	0,02	0,05	0,14

Based on previous research (Ditman and Kuperberg, 2010), we expected participants with schizophrenia to have lower scores on local and global coherence measures, and score somewhat lower on informativeness measures due to executive dysfunction. However, we have found no significant group differences, which can be in part explained by high heterogeneity of symptoms in schizophrenia that is further complicated by different treatment strategies.

Aphasia Rapid Test: Adaptation for Russian

Olga Buivolova¹, Oxana Vinter², Roelien Bastiaanse^{1,3}, Olga Dragoy¹

¹ Higher School of Economics

² Moscow Municipal Clinical Hospital N31

³ University of Groningen

The Aphasia Rapid Test (ART; Azuar et al., 2013) is a bedside screening test for people in acute stroke period designed as a 26-point scale estimating the severity of speech and language disorders in 5 minutes. This study shows a case of adaptation of the ART for Russian.

The adapted version of the ART was tested in a Russian-speaking clinical group in the acute stroke period (N=49, 20 females, mean age 69, range 40-88) and in a control group of healthy Russian speakers (N=18, 11 females, mean age 25.4, range 18-44). The severity of language and speech disorders was scored by speech therapist with the scale from 0 to 6. Control group also performed the Russian e-version of the Token Test (Akinina et al., 2015). The Russian adaptation of the ART was made using an original set of stimuli relevant for Russian and included 5 tasks assessing: i) the ability to follow two simple and one complex instructions; ii) repetition of three single nouns with different numbers of articulatory switches; iii) repetition of one simple sentence; iv) naming of three objects presented in the pictures; v) semantic fluency (1-minute task). Dysarthria severity was also assessed. All tasks were scored as in the original ART (26 points maximum).

Healthy controls obtained the maximum score on the ART and the average result on Token Test was 34.9 points – all above the aphasia threshold (> 28). The average result on the ART in the clinical group was 6.08 points and 3.14 by speech therapist's assessment; the results of both tests correlated positively ($\rho = 0.55$, $p < 0.01$).

Preliminary results showed that the Russian version of the Aphasia Rapid Test is a sensitive tool for early aphasia assessment. However, this should be further verified on a larger sample. If the Russian version of the ART could be shown to be a valid and reliable screening tool after standardization on a large sample, it may in the future be considered for integration into clinical practice for rapid speech and language assessment.

Brain Activity, Lateral Asymmetry Profile and Speech Features of Children Aged 5-14 Years

Elena Lyakso¹, Anna Kurazhova¹, Olga Frolova¹

¹ Saint Petersburg State University

The goal of the study is to investigate correlations between psychophysiological and speech features of typically developing (TD) children aged 5-14 years. Whereas correlations between characteristics of brain activity and different aspects of behavior (e. g., Farber, Bezrukih, 2009; Machinskaya et al., 1997-2016, Brito et al., 2016) and reading skills (Lyakso et al., 2012; Partanen et al., 2018) are often studied, similar data on the speech acoustic features and brain activity development of Russian children are absent.

The participants of the study were 59 TD children. For all participants the electroencephalogram (EEG) was recorded and analyzed, dichotic test was run, speech was recorded and instrumentally analyzed. The analysis of EEG (rhythms and their localization), child's psychophysiological and speech features revealed the following links: Child's age correlates with expression of alpha-rhythm in EEG (0.78–Spearman correlation, $p < 0.05$), vowel articulation index (VAI – indicates the articulation accuracy) (0.77), and use of complex sentences. Multiple Regression analysis revealed that child's age is predictor $F(8.33) = 5.228$ $p < 0.0002$ $R^2 = 0.559$ of complex sentences use ($B = 0.643$ $p < 0.02$), pitch (F0) values ($B = -0.443$ $p < 0.009$), and F0 range values ($B = 0.473$ $p < 0.01$). VAI correlates with F0 values (-0.79). Correlation between VAI and reading skills formation (-0.76) is revealed. When reading phrases fluently, children do not articulate sounds as clearly as when reading by syllables. Regression analysis confirms correlation between theta-rhythm and alpha-rhythm, $F(1.57) = 10.194$ $p < 0.002$ ($B = 0.389$ $R^2 = 0.152$), as well as theta-rhythm and F0 values, $F(1.44) = 6.384$ $p < 0.015$ ($B = 0.356$ $R^2 = 0.127$). Multiple Regression analysis confirms the correlation between theta-rhythm and F0 range, $F(5.40) = 2.356$ $p < 0.05$ ($B = 0.424$ $R^2 = 0.227$). The coefficient of lateral asymmetry profile (dichotic test) correlates with the response complexity. Child's VAI correlates with the asymmetric localization of the alpha-rhythm, $F(1.44) = 5.931$ $p < 0.01$ ($B = 0.345$ $R^2 = 0.119$). Correlation between the child's weight at birth and VAI in preschool age was also revealed $F(1,29) = 6,519$ $p < 0,01$ ($B = -0,428$ $R^2 = 0.184$).

Direct and indirect relations between speech, cognitive development and psychophysiological characteristics of the child are demonstrated here, which allows making a conclusion about complex development trajectory and describing a normative way of child's development.

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Creating Novel Metaphors: The Role of Cognitive Control and Broad Equivalence Range

Iana Bashmakova¹, Olga Shcherbakova¹

¹ Saint Petersburg State University

Metaphor production is strongly linked to creativity (Beaty & Silvia 2012). While there is no consensus on the nature of creativity itself, many studies suggest its connection to intelligence through the implementation of cognitive control mechanisms (Nusbaum & Silvia 2011). Kholodnaya (2012) states that cognitive control plays a major role in cognitive styles, including equivalence range (ER). Broad ER seems to be important for metaphor production, as this cognitive style supports discovering similarities between different concepts. This leads us to prediction of ER involvement in novel metaphor creation. We also proposed that using different strategies for composing metaphoric representations (Bashmakova & Avanesyan 2016), which also rely on cognitive control, would explain possible variance in metaphor quality scores (MQS).

Participants ($n = 42$; native Russian speakers; aged 18-24; $M = 20,14$), divided into 2 groups, completed a series of tasks. The first task was to create a metaphor that described the concept 'curiosity'. The remaining tasks required using 3 strategies for composing metaphoric representations and were presented in a different order for each group. The strategies were as follows: 1) change of an idea (creating a metaphor on the same topic but using completely different idea and representation); 2) transformation (applying a different metaphoric representation that conveys the same idea); 3) extension (elaborating or expanding of the previously produced metaphor). To assess ER, we used the 'Free Sorting Test' by R. Gardner.

Friedman test showed a decline in MQS from task to task, but only for participants with lower cognitive control: the scores dropped significantly for the ones who did not implement suggested strategies ($p = .001$). High level of cognitive control seems to be crucial for the ability to come up with different creative ideas that are appropriate to the task while maintaining the same level of quality. MQS also correlated with broad ER ($r = .457$, $p = .014$): metaphor creation appears to require the skill to find similarities and dismiss differences between concepts. Mann-Whitney U-test showed no differences in groups' MQS, which indicates that certain strategies had no significant effect on the MQS. It may indicate that cognitive control plays a greater role in creating novel metaphors than specific strategies for the composition of metaphoric representations.

Dependence of the Manifestation of Processes of Multisensory Integration in Children With Different Levels of Speech Development

Liudmila Cherenkova¹, Liudmila Sokolova¹

¹ Saint Petersburg State University

One of the important directions in the study of perception is the definition of mechanisms of multisensory integration, which allow the body to more accurately judge the objects of the surrounding world. Of particular interest in the ontogenetic aspect is the study of the specifics of the formation of mechanisms of multisensory integration in children with speech disorders.

The study involved 62 children (30 children with typical development (TD), mean age 6.7 ± 0.2 years, and 32 children with a diagnosis of “residual-organic-based mental retardation” (MR), the average age was 6.1 ± 0.5 years). Children with MR were characterized by different levels of general speech underdevelopment (GSU): 10 children had GSU level IV-III; 12 children - III, 10 children - III-II. The study used a priming paradigm. As test stimuli, we used animal sounds (kitten and puppy). As prime stimuli, we presented images of these animals combined with the test sound stimuli either congruently or incongruently. The interstimulus interval (ISI) between presentation of the prime and the test stimuli varied from 0 to 500 ms.

In TD children, we found a facilitatory effect of congruence on discrimination latency when ISI was in the range of 50-100 and 200-500 ms. In children with MR the manifestation of facilitating influence depended on the GSU level. In children with IV-III level of GSU the facilitating effect was observed at ISI in the range of 50-150 and 300-500 ms, in children with level III of GSU — 200-500 ms, and in children with III-II level of GSU — 300-500 ms. Thus, in children with MR, the time window of the facilitatory effect was expanded and shifted in comparison with TD children. The degree of change in the effect time window of depended on the level of the GSU.

In studies of the processes of multisensory integration, expansion and shift of the time window of such effects are associated with the slowing down of the processes of multisensory integration. Consequently, it can be assumed that in children with MR there are the deficits un development of multisensory integration processes, the level of which depends on the manifestation of speech defects.

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Does COATS Prime COAST? Masked Priming With Transposed-Letter Noun Forms in Russian

Svetlana Alexeeva¹, Vladislav Mikhailov²

¹ Saint Petersburg State University

² Higher School of Economics

The role of orthographic neighbors (e.g. trail – trial) in word processing has been discussed in many experimental studies. These studies address the problem of visual word recognition, lexical access in the mental lexicon and a number of other topics that are currently under debate in psycholinguistics. A number of experiments on transposition neighbors (e.g. Christianson et al. 2005; Perea, Carreiras 2006; Duñabeitia et al. 2007; Rueckl, Rimzhim 2011) raised the following question: does it play a role whether the transposition takes place inside one morpheme or across the morphological boundary? This lets us understand whether multimorphemic words are decomposed during word processing and if they are, at what stage. Unlike the majority of earlier studies, our experiment investigates inflected forms rather than derived words.

We conducted a masked priming lexical decision experiment on Russian that examined the relationship between pairs of real words that differed only in two adjacent letters (e.g., klonu ‘cloneDAT.SG’ vs. kloun ‘clownNOM.SG’) that were transposed. All primes were noun forms in oblique cases, targets were real nouns in nominative singular or nonce nouns. Primes were presented for 200 ms. Two factors were manipulated: whether the prime was a transposed-letter (TL) neighbor of the target (experimental vs. control condition); whether the prime was more/less frequent than the target. The transposition always occurs across morphological boundaries (between root and inflection).

Statistical analysis using mixed-effect linear modeling showed that high-frequency TL neighbors significantly increased response latencies compared to the control condition, whereas low-frequency TL neighbors facilitated recognition of the targets.

Discussion. The results let us conclude that high-frequency Russian noun forms in oblique cases are stored as a whole. They compete with lexical items that share all their letters, therefore the lexical inhibition occurs. As for low-frequency noun forms, they probably require some kind of morphological processing, that puts the lexical activation on hold. Therefore, we registered facilitation caused by the overlapping letters, rather than inhibition due to lexical competition.

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Electrophysiological Correlates of the Drift Diffusion Model in a Masked-Priming Lexical Decision Task

Marta Vergara-Martínez¹, Xavier Duart¹, Pablo Gomez², Manuel Perea¹

¹ University of Valencia

² DePaul University

Together with the analysis of Event Related Potentials (ERPs), the Drift Diffusion Model (DDM) sheds light on the different stages of information processing in the lexical decision task. Here we inquire about the common mechanisms underlying behavioural and ERP effects as obtained in the masked identity priming lexical decision experiment reported by Vergara-Martínez et al. (2015): response times (RTs) to matched-case PRIME-TARGET pairs (JUDGE-JUDGE) mimicked those of mismatched-case prime-TARGET pairs (judge-JUDGE). Although this favours a bottom-up abstract encoding of orthography very early during visual word recognition, the results for nonwords qualified a different conclusion: RTs to matched-case PRIME-TARGET pairs were faster than the RTs to mismatched-case prime-TARGET pairs (JUDPE-JUDPE < judpe-JUDPE). Moreover, although case effects were obtained at the N/P150 (an early perceptual component) for words and nonwords, they vanished for words around 250 ms post-target (N250) but not for nonwords. Hence, the N250 signals the interface between orthographic abstract encoding and lexical feedback. To investigate the relationships between the DDM parameters and ERP effects, we first calculated the DDM parameters that fitted the behavioural data: 1) the drift rate (the rate at which information from stimuli accumulates towards the boundary in any binary decision); and 2) a nondecision parameter named Ter (which represents other components of processing, such as encoding and response execution). Only Ter showed a case effect for nonwords. Accordingly, we computed the correlations between the effect in Ter and the N250 case-effect and obtained a significant correlation for nonwords. No other significant correlation was obtained between the parameters of the DDM and the ERP effects. These results suggest that: 1) the behavioural effects in the Vergara-Martínez et al. (2015) experiment originated from non-decisional processes (encoding processes); and 2) the neural activity underlying the N250 effects, which seems to also feed into the behavioural processes, has a non-decisional nature. In sum, the combination of non-invasive measures (EEG) and the modelling of behavioural responses using mathematical models (DDM) may help refine the interpretation of the functional meaning of electrophysiological information, such as the time course of the underlying sublexical or lexical effects.

Good-Enough Processing in Adolescents and Adults: The Effect of Background Noise

Anastasiya Lopukhina¹, Svetlana Maljutina¹, Anna Laurinavichyute¹, Anastasia Antonova¹, Galina Ryazanskaya¹, Elena Savinova¹, Alexandra Simdyanova¹

¹ Higher School of Economics, Moscow

Studies of language processing in adolescents demonstrate that young speakers still acquire language competence on lexical, syntactic, and discourse levels between 13–19 years. In this study, we investigate how Russian speaking adolescents use sentence processing strategies when reading complex syntactic structures. In particular, we study (1) to what extent adolescents rely on the good-enough processing strategy (Ferreira & Patson, 2007) as compared with adults; and (2) how linguistic noise influences processing in both adolescents and adults. Good-enough approach assumes that people do not always engage in detailed algorithmic processing of linguistic input. Rather, the parser forms shallow representations based on word meanings and world knowledge when confronted with some difficulty such as complex syntactic structure, or noisy input.

We ran four self-paced reading experiments in groups of adolescents (N = 20, MAge = 15) and young adults (N = 20, MAge = 29). Two experiments were run in silent conditions and the other two — in the presence of three-talker babble of voices. Stimulus examples: Римма одевала малышку писательницы, (1) лепечущую // (4) лепечущей непонятные слова, or: Римма одевала малышку писательницы, (2) опубликовавшей // (3) опубликовавшую интересный роман. After each sentence, we asked participants a comprehension question. If participants chose a semantically appropriate but syntactically incorrect answer in sentences (3) and (4) they would be proven to rely on the good-enough strategy. We also measured their reading times. We found that both adolescents and adults made more mistakes in sentences (3) and (4) ($p < 0.001$), as compared with sentence (1). It means that adolescents rely on the good-enough processing strategy like adults. In noisy conditions, adults read faster than adolescents ($p = 0.01$). It could mean that background noise is more harmful to language processing in adolescents as their executive functions are not fully developed.

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Good-Enough Processing in Younger and Older Adults: Data from Russian Non-Finite Clauses

Anastasia Antonova¹, Svetlana Malyutina¹

¹ Higher School of Economics

According to the “good-enough” approach to language comprehension (GE), language users do not always engage in full algorithmic processing of linguistic input (Ferreira et al., 2002). Rather, we often form superficial representations based on heuristics such as lexical content of the sentence and world knowledge. But little is known about what factors trigger increased reliance on GE over algorithmic language processing. In this study, we tested two such potential factors: aging and cognitive load. Thirty six young people (age: 18-30 years, average 22 years, 8 males and 28 females) and 33 older adults (age: 59-84 years, average 71 years, 6 males and 27 females) read sentences and answered binary-choice comprehension questions. In the high cognitive load condition, sentences were presented word-by-word; in the low cognitive load condition, sentences were presented as a whole. Stimuli included semantically plausible sentences, where syntactically correct parsing is also the most probable parsing based on lexico-semantic cues (e.g. «Я увидел бабушку актрисы, получавшую большую пенсию»), versus semantically implausible sentences (e.g. «Я увидел бабушку актрисы, получавшей большую пенсию»). In this experiment, we used two experimental blocks, with 20 experimental sentences and 30 fillers in each. We used the difference in comprehension accuracy in semantically plausible and implausible condition as a proxy for reliance on GE language processing.

According to the statistical analysis in R (linear mixed effects model) accuracy was higher in plausible sentences ($\chi^2(1) = 34.12$, $p < .001$; reaction times were faster in plausible sentences ($\chi^2(1) = 6.10$, $p = .014$) and at low cognitive load ($\chi^2(1) = 9.30$, $p = 0.002$); younger people responded faster than older ones ($\chi^2(1) = 19.90$, $p < .001$). The results present an evidence that people rely on GE language processing as they made more mistakes in implausible sentences and read them slower.

Impact of Modality (Visual or Auditory) on Neurophysiological Bases of Text Processing in Adolescents

Olga Kruchinina¹, Elizaveta Galperina²

¹ Sechenov Institute of Evolutionary Physiology and Biochemistry RAS, St-Petersburg, Russia;

² Saint Petersburg State Pediatric Medical University, St-Petersburg, Russia.

The specificity of spatial brain potentials organization influenced by different modality of text presentation is still not well understood. The adolescence is an important critical period not only for physiological maturation, but also cognitive development, in particular, the formation of the comprehension skill and text processing. The study aimed to investigate the functional integration of different cortical areas during texts visual perception or listening comprehension in adolescents of 11-13 years old.

Subjects (N=37, 16 male) had to process two texts, one of them presented on the monitor and other by headphones, during EEG recording. 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 Modality of text impact (visual perception or listening comprehension), Sex (male vs. female) on the EEG parameters, we used ANOVA.

Significant effects of the ‘Sex’ and ‘Modality’ factors on the total SSBP level were revealed. In boys, the level of SSBP during listening comprehension was higher in frontal areas bilaterally (Fp1, Fp2, F3, F4) compared to the rest. During visual text processing, SSBP level was higher in occipital and parietal areas bilaterally (O1, O2, P3, P4, TP1, TP2). In girls, the level of SSBP during listening comprehension was higher in left temporal areas (T3, T5) compared to the rest. During visual text processing, SSBP level was higher in right temporal area (T2).

Sex differences in EEG spatial synchronization in adolescents of 11-13 years old during texts visual perception or listening comprehension were revealed. In girls, the modality of the presented text influenced the left/right temporal areas involvement during comprehension, while in boys, the modality influenced the frontal and occipito-parietal areas involvement.

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Interhemispheric Functional Asymmetry of the Frontal Region in Children of 4-7 Years of Age with Learning Disabilities

Elena Nikolaeva¹, Tatiana Brisberg²

¹ Herzen State Pedagogical University

² Eletz State University

Speech is a lateralized process. It is believed that problems with children's speech formation can be determined not by structural disorders in the center of speech, but by the specifics of the relationship of the brain hemispheres which complicates the effective formation of the brain (Goldberg, 2003). The task of this research was to verify the assumption that the cause of the delay in children's speech development may be excessive right hemisphere activation, which can suppress the left hemisphere activation.

30 children (20 boys and 10 girls) aged 4 to 7 years ($5,5 \pm 1,1$ years) with learning disabilities were participants in the study. All children were examined by a neurologist and a speech therapist. In symmetrical prefrontal leads of the left and right hemispheres the dynamics of sustainable potential (UP) of the brain were evaluated using miniature silver chloride electrodes. We evaluated the degree of change in coherence in the functioning of the hemispheres of the brain.

Children with learning disabilities showed that there is a high level of coherence activity in the frontal areas of the right and left hemispheres, whereas a shift of the functional state entails a reduction in the level of this consistency. The more severe the learning disabilities were, the more probability was of no change in the level of coordination of activity of hemispheres during the transition from one functional state to another. The worse the level of speech development was, the higher activity of the right hemisphere was revealed.

Our data are consistent with the hypothesis of a higher level of activation of the right hemisphere as opposed to the left one in children with speech problems. These children also show more rigid brain activation processes.

Intonation in Reading as Automatic and Conscious Processing by the Reader

Iuliia Nenasheva¹, Olga Sedlyarova¹, Natalya Solovyeva¹

¹ Magnitogorsk State Technical University

Automatic (parallel) and conscious (successive) processing of information by the reader can be investigated by complex study which includes corpus analysis of the written text and acoustic analysis of its read variant. The corpus analysis identifies elements of the text which serve as markers/primers for the reader to identify the semantic content of the utterance. The acoustic analysis serves to describe intonation contours and prosodic components used by the reader. The study uses book characters' direct speech utterances read by the reader. The utterances are characterized by imperative syntactic structure.

The study shows that intonation contours of utterances can be organized into fuzzy sets which correspond to basic types of semantic information contained in the utterance (command/request). The basic semantic division is complicated by additional expressive/emotive information. The fuzzy sets have the central parts and peripheral areas which may overlap with peripheral areas of other fuzzy sets. The central part of the fuzzy set contains most frequent intonation contours with simpler structure. The peripheral areas contain intonation contours with more prosodic variation. The prosodic variation in overlapping peripheral areas of fuzzy sets may result in intonational/prosodic homophones.

The organization of intonation contours into fuzzy sets reflects the way the reader processes information conveyed by the utterances. Automatic (parallel) processing is activated without conscious effort and does not involve using additional cognitive resources. Utterances with this intonation structure are rarely accompanied by primers/markers. Automatic (parallel) processing is represented by most frequent intonation contour types with basic simple prosodic structure and limited prosodic variation. Utterances which involve conscious (successive) processing are characterized by primers/markers of additional expressive/emotive information. Intonation contours that represent the result of conscious (successive) processing comprise peripheral areas of fuzzy sets. These utterances possess more complex prosodic structure and are characterized by greater prosodic variation. There is some paradox in that conscious effort results in more ambiguous intonation contours. This ambiguity is compensated by the primers/markers.

Investigation of Verbal Stimuli for Psycholinguistical Experiments via Machine Learning

Bogdan Kirillov¹, Alexandra Petrovskaya^{2,3},
Anastasiya Asmolova³, Matteo Feurra³

¹ Skolkovo Institute of Science and Technology (Skoltech)

² Institute of Developmental Biology, RAS

³ Higher School of Economics

Adaptation of experimental verbal material between studies and/or between languages is a challenging task in Psycholinguistics. To replicate experimental results the researchers should choose characteristics of interest that conserve detected behavioral effects. We use Machine Learning in attempt to determine specific characteristics of the material that trigger certain behavioral response. To find characteristics of language material that affect adaptation success we test episodic memory because memory tasks are highly sensitive to morphology, semantics and phonetics of the verbal stimuli. To do so, we use translated verbal material from study of episodic memory conducted by Medvedeva and colleagues (2018). Our computational approach is based on classification of words represented by word embeddings that approximate semantic distance between words such as word2vec and GloVe.

The main idea behind word2vec and GloVe is to map the words to n-dimensional vectors in a way that makes the distances between vectors as close as possible to semantic distances between words. The real semantic distances are usually measured using estimations made by participants. One considers distances in vector space close to distances in word space if human-made estimates highly correlate with computed values. Thus, we can assess how ability to recall depends on semantics of words and detect differences between languages that may affect recall ability.

The procedure is as follows: on the first day participants were asked to memorize separate words via evaluation of each word. On the following day participants performed a standard recognition task. The main idea is to predict whether the word was forgotten or recalled given its vector representation or other word characteristics.

When the correspondence of stimuli in Russian and English corpora is high, vocabulary-based translation is optimal. Preliminary results of Machine Learning-based model show that words with ambiguous meaning tend to be more difficult to recall.

Application of Machine Learning thus appears helpful in detection of the differences that affect adaptation of verbal stimuli to another language, especially when stimuli are polysemic or with high standard deviation of frequency. For studies where morphological characteristics are similar and semantics is transparent, the effect of differences is negligible and traditional word per word translation approach may be sufficient.

Language and Motion: Isolated Modules or Interconnected Levels?

Olga B. Sizova¹

¹ Institute for Linguistic Studies, RAS

Cognitive studies appeal to the specific language impairment (SLI) as an argument for the encapsulation of the language mechanism. The absence of apraxia in children with SLI is considered a confirmation of the isolation of language disorder. In repetition of syllables, these children do not show the articulatory failures that are characteristic of their speech. The aim of the study is to identify the interrelation between the characteristics of the motor and language spheres in LI.

Three experiments were run to identify: the features of general motor activity; the articulatory praxis (repetition of syllables); the functions of language analysis and synthesis (differentiation and synthesizing of linguistic units). The informants with 20 preschoolers with LI in a longitudinal study. The children were divided into 2 groups according to the features of the motor sphere. In the 1st group the failures of pose reproduction prevail, while in the 2nd group the organization of movements sequence was complicated. In repetition of syllables, young children made mistakes, the mechanisms of which were in line with their motor disturbances; older children almost never made such errors.

Notably, young children perceive the presented syllables as information codes and try to recognize words in them. For a speaking child, syllable repetition is a task performed at the linguistic level, and not at the level of non-linguistic praxis. For older children, the repetition of two equally accented syllables is easier than most words. The conditions for production of utterances and repetition of syllables differ not in levels of movements' realization, but in different technical complexity of movements on the language level. However, the similarity of errors mechanism in body movements and in articulatory movements confirms the interrelation between functions of motor and language levels.

The results of language synthesis are better in children with difficulties in finding a pose, while analytical linguistic processing is better in children with difficulties in consistent organization of movements. More intact motor mechanisms ensure the development of one of language strategies. Children of the 1st group develop a synthetic strategy based on the intact ability to organize the sequence, which is a purposeful synthesis of elements. Children of the 2nd group accurately realize elements of the movement and develop an analytical strategy based on accuracy of recognition and differentiation of significant units.

Morphological Processing Across the Lifespan: Evidence from an Illusory Conjunctions Paradigm

Elena Savinova¹, Daria Zharikova¹, Svetlana Malyutina¹

¹ Higher School of Economics

The major question in morphological processing is the mechanism of recognition of multi-morphemic words, i.e. whether they are accessed as a single unit (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 of morphological processing change across the lifespan, namely, reliance on direct access increases with age (Reifegerste et al., 2016). The goal of our study is to track these changes across three age groups.

The participants were 20 adolescents (11-14 y.o.), 36 younger (19-30 y.o.) and 16 older (60-80 y.o.) native speakers of Russian. An illusory conjunctions paradigm (Prinzmetal et al., 1991) was used: a word printed in 2 colors shortly appeared on the screen, then reappeared in black font and participants indicated the color of the underlined letter. Accuracy rates were analyzed. The stimuli included 120 adjectives, divided into 6 conditions: errors were expected when there was a mismatch of the morphemic and color boundary: i.e. the target letter differed in color from the rest of the morpheme. There were also control mono-morphemic nouns and fillers.

The experiment revealed a main effect of age ($F(2,69)=9.69$, $p<.001$; younger adults were more accurate than older people or adolescents), condition ($F(5,65)=15.92$, $p<.001$) and a significant Age x Condition interaction ($F(10,132)=2.06$, $p=.032$): conditions had different effects across age groups. Paired t-tests in adolescents ($t(19)=2.31$, $p=.032$), younger ($t(35)=3.43$, $p=.002$) and older ($t(15)=3.00$, $p=.009$) people revealed lower accuracy in case of color-morphemic mismatch only when the color boundary was after (younger, older) or before (adolescents) the morphemic boundary. However, the pattern held for equivalent conditions in control nouns, showing that the effects in adjectives were not due to morphological decomposition. Also, significantly more errors occurred with violation of the syllabic, rather than morphemic boundary ($p<.005$ in all age groups).

No crucial differences in processing of multi-morphemic words were revealed across the age groups. Moreover, morphological effects were obscured by syllabic effects, suggesting that morphemes are not the most prominent sublexical processing units and that decomposition into morphemes is not obligatory in recognizing multi-morphemic words in a single-word task.

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Neural Correlates of Fast Mapping of Novel Words Through a Single Exposure: An ERP Study

Marina Vasilyeva¹, Veronika Knyazeva¹, Alexander Alexandrov¹, Yury Shtyrov^{1,2}

¹ Saint Petersburg State University

² Aarhus University, Denmark

Rapid new word acquisition could be mediated by general learning mechanism known as *fast mapping* (FM). FM refers to a process of incidental exclusion-based learning which promotes rapid integration of newly learned items into cortical memory networks. Recent neuroimaging research in adults emphasized that FM may induce rapid neocortical plasticity to create novel word-object associations, largely supported by the left temporal lobe (Atir-Sharon et al., 2015). While several ERP studies suggested an increase of early activity in fronto-temporal cortical networks as an index of rapid learning of novel word forms after a mass exposure (Shtyrov, 2011; Kimppa et al., 2015), the neurophysiological mechanisms of FM still remain poorly understood. The objective of the present study was to identify ERP correlates of FM in adults.

Ten right-handed native Russian speakers were presented with four acoustically and phonetically similar CVC triphones: 2 familiar words (*k'it* - whale; *kot* - cat) and 2 phonologically legal novel word forms (*kat*; *k'et*). In a passive trial, the stimuli were binaurally presented through the headphones in pseudo-random order. In FM condition the subject was asked to identify one object among pictures of 5 animals presented on the screen. This could either be a familiar word-object pair (e.g., goose, horse, cat), or, critically, a new word paired with a novel item displayed beside 4 pictures of familiar animals; following this, passive EEG recording was repeated. 32-channel EEG was recorded and ERPs were calculated relative to stimulus onsets.

Amplitudes analysis was carried out for fronto-central electrode cluster. A significant increase in the ERP amplitude over the 192-460 ms window was found for the novel word used when comparing the response before and after the FM condition ($F(1, 9) = 6.737$; $p = 0.029$). Furthermore, ERP amplitude was significantly increased over the left hemisphere in the late (368-460 ms) segment ($F(1, 9) = 7.540$; $p = 0.023$).

We propose that FM promotes incidental rapid integration of new associations into existing neocortical semantic networks as has been indicated by the rapid changes in ERPs present after a single exposure to a novel item. Future studies are needed to generalize the current result to larger stimulus groups and to clarify the neuroanatomical underpinnings of this mechanism and its implementation in children.

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Neural Responses to Inflections in Finnish During Semi-Overt Production: An fMRI Study

Laura Hedlund^{1,3}, Patrik Wikman¹,
Suzanne C.A. Hut^{1,4}, Tatu Huovilainen¹, Alina Leminen^{1,2}

- ¹ Cognitive Brain Research Unit, Department of Psychology and Logopedics, Faculty of Medicine, University of Helsinki
- ² Cognitive Science, Department of Digital Humanities, University of Helsinki
- ³ Aalto NeuroImaging, AMI Centre, Aalto University
- ⁴ Department of Intensive Care Medicine, University Medical Center Utrecht

Current models of neural mechanisms of morphological processing, and production in particular, do not account for all languages. A specific feature of the Finnish language is a lack of irregularity in the inflectional system. Currently, there is scarce behavioral evidence on the processing of stem changes during inflection in agglutinative languages. Neural evidence is also absent in regards to generating inflected words online, for both words that do, and do not undergo stem changes (gradation).

To address these issues, we used a semi-overt production task during event-related functional magnetic resonance imaging (fMRI). Participants performed an acceptability judgment of visually presented complex words in 85% of trials. In the other 15% of the trials the inflected version of a visually presented stem was overtly produced. We found that pseudowords (that either underwent gradation or not) activated regions in the left inferior frontal gyrus (LIFG, BA 44/45) more strongly in comparison to both high and low frequency gradated and non-gradated stem group counterparts. This could be interpreted as Finnish native speakers using more processing power to apply grammatical rules for gradated stems. This becomes especially apparent for gradated pseudostems, as memory traces for these items do not exist. In addition, we observed cerebellar activation in areas VIII A, B, and VIIB, which are typically associated with working memory and the creation of motor memory traces. Pseudowords had the least amount of cerebellar activation compared to both stem groups, suggesting that this area may not only be associated with motor memory traces, but also memory traces for lexical items. Taken together, we present novel, and more detailed findings linking the cerebellum and left frontal cortical regions to online production of morphologically complex words, paving the way for a more holistic cross-linguistic neurocognitive model of morphosyntactic parsing.

Sensory Motor Disorders of Children with Language Impairments

Victoria Efimova¹, Oleg Efimov¹, Tatiana Dudetskaia¹, Vladimir Rozhkov¹

¹ LLC Prognoz

Children with language impairments and learning difficulties are known to have signs of sensory motor disorders. Jean Ayres believed the bases of sensory integration were vestibular afferents. Vestibular system is one of the first to develop from the fourth week of gestation. The development of the system may be impaired because of different factors. As a result of vestibular dysfunctions all cognitive processes can be impaired, because in this case they are carried out on the basis of distorted perception processes. Our goal was to investigate signs of sensory motor integration dysfunctions in children with different language disorders with the help of Vestibular Evoked Myogenic Potentials (VEMP).

260 children were examined, including 150 children with language impairment (age 2 – 7.4), 46 children with specific developmental disorders of scholastic skills, SDDSS (age 7.1 - 16) and 34 children on the autistic spectrum (age 2.5 – 10.9). VEMP responses to sound stimulation were registered using a Neuro-MVP-4 evoked potential response unit (Neurosoft, Ivanovo). Clicks of 130 dB USD and 0.5 sec were presented through headphones. Latency of P13 and N23 waves was evaluated from muscle Sternocleidomastoideus on the side of click presentation (saccule and cervical reflex).

Vestibular dysfunctions were found in 26% of children with speech disorders, 57% of school children with SDDSS and 18% of children on the autistic spectrum. Time delay manifested itself as the increase in latency of P13 wave in comparison with the reference value of 12 ms. These results show that language disorders can result from a prenatal period of development of the systems responsible for integration of motor and sensory processes. VEMP allows to detect underlying vestibular dysfunctions in children with language disorders that may potentially be important for intervention.

The Study of Brain Mechanisms of Formally Logical and Empirical Thinking in Healthy Subjects

Diana M. Guillemard¹, Mikhail Tsitseroshin¹, Larisa Zaytseva¹, Ekaterina Panasevich¹, Liudmila Tsaparina¹

¹ Sechenov Institute of Evolutionary Physiology and Biochemistry of RAS

The ability of logical inference operations is one of the basic cognitive functions. In the works of Deglin and Chernigovskaja (1986, 1996), when solving syllogisms with correct or false assumptions, it was shown that in the conditions of transient suppression of one of the hemispheres, the brain uses either the “empirical” method of solution (in the case of only right hemispheric activity), or “theoretical”- verbal-logical in case of preservation of only the left hemispheric function. The only scarce data on joint or separate involvement of the two hemispheres in neurologically healthy subjects in solving syllogisms are related to the works of V. Goel (Goel and Dolan, 2003; Goel, V. et al., 2004, 2007). It noted a special role of the prefrontal cortex of the right hemisphere in solving syllogisms with non-deterministic relationships between objects (Goel et al., 2007). In the present work, we investigated the systemic reorganization of regional interactions of cortical bioelectric activity in clinically healthy subjects in solving syllogisms with false and correct messages. The analysis of EEG correlations between 20 cortical regions showed that in the group of subjects, who correctly solved syllogisms with false premises (i.e. based on empirical thinking), there was a significant increase in statistical interactions of biopotentials of the right hemispheric cortex. In another group of subjects, which persistently made mistakes in solving syllogisms with false statements (i.e., based on formal logical thinking), an increase of statistical EEG interaction was observed mainly in the left hemisphere cortex. Thus, the results of the study showed clear differences in the lateralization of the strengthening of regional interactions of the left or right hemispheres cortical centers in the cases of the solution of syllogisms on the basis of formal-logical or empirical types of thinking.

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Poster presentations. Day 2

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Narrative Processing in Patients With Left and Right Temporal Lobe Epilepsy

Vardan Arutiunian¹, Anna Yurchenko¹, Alexander Golovtsev², Olga Dragoy¹

¹ Higher School of Economics

² Epilepsy Center, Moscow, Russia

Studies on language processing in patients with temporal lobe epilepsy (TLE) usually focus on word and sentence processing, whereas the number of research on discourse comprehension is limited. Some studies revealed the difficulties in short stories comprehension in patients with both left and right TLE (Giovagnoli et al., 2011; Lomlodjian et al., 2017). In addition, patients with right TLE showed lower ability to understand social meaning of the story. However, it is still unclear how patients with TLE perceive information related to the main line and details of the narrative. In our study, we analyzed comprehension of a longer narrative by patients with TLE using questions concerning the main line of the story and its details.

Twenty patients with left TLE (10 females, M age = 30 years, age range = 15-56 years), 20 patients with right TLE (14 females, M age = 30 years, age range = 16-57 years) and 20 healthy controls (12 females, M age = 32 years, age range = 19-55 years) participated in the experiment.

Participants listened to a narrative (Ivanova et al., 2016) and answered 16 questions half of which were related to the main line of the story, whereas the other half addressed its details.

There was a significant difference between the three groups of participants in the total number of correct answers ($p = 0.011$) and number of correct answers to the questions concerning the main line of the story ($p = 0.006$). As compared to healthy individuals, the total number of correct answers was significantly lower in patients with left TLE (86% vs. 97%, $p = 0.024$) and right TLE (90% vs. 97%, $p = 0.035$). Similarly, patients with left TLE gave significantly less correct answers related to the main line of the story as compared to healthy subjects (88% vs. 99%, $p = 0.033$). The difference (at a tendency level) was also found between patients with right TLE and healthy controls (91% vs. 99%, $p = 0.078$). In contrast, there was no significant difference in number of correct answers concerning the details of the story across the three groups of participants.

Our results show impairments in discourse comprehension in patients with both left and right TLE. The observed difficulties were more prominent for the main line of the narrative, whereas patients and healthy controls performed comparable number of errors related to the details of the story.

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Newborn Infants Show Predictive Inference of Syllables in Word-Like Items

Emma Suppanen¹, Istvan Winkler², Teija Kujala¹, Sari Ylinen¹

¹ University of Helsinki ² Hungarian Academy of Sciences

To facilitate adaptive behavior, the brain aims to predict future sensory events. A recent study by Ylinen et al. (2017, *Developmental Science*) showed that such predictive inference is linked with word recognition and learning in 12- and 24-month-old children. Negative-polarity auditory event-related potentials (ERPs) were elicited when the preceding word context predicted familiar word endings, whereas word-expectancy violations generated prediction error (PE) responses of positive polarity. PE strength correlated with vocabulary scores at 12 months.

Here we aimed to investigate whether the facilitative effect of predictive inference on learning from auditory input can be observed already in newborn infants. We exposed newborn infants ($N=74$, mean age 9.2 days) to bisyllabic pseudowords AB and CD ($p=0.5$ for each) during ERP measurement. Then we used an oddball paradigm to probe prediction and learning effects. Standard stimulus was the familiarized pseudoword AB ($p=0.8$), where A was expected to create predictions of B if learned. Occasional deviant pseudowords were CD, CB, AD and AX ($p=0.05$ for each). We expected correct predictions to elicit suppressed responses, and prediction errors to elicit larger responses.

We repeated the measurement when subjects were 12-month-olds ($N=40$ at the moment, mean age 367 days). The deviant pseudoword CB was left out from stimuli presented to 12-month-olds in order to make the measurement time shorter ($p=0.79$ for standard and $p=0.07$ for each deviant word-like item).

In newborns, AD and AX violating the predictions elicited significant PE responses of positive polarity. In contrast, familiarized CD elicited a negative response, resembling the word familiarity effect observed at 12 months by Ylinen et al. (2017). The same kind of pattern repeated for 12-month-olds with faster responses to AD than AX.

The findings suggest that newborns can learn to recognize potential words. Importantly, their brain automatically creates predictions about word endings after hearing a familiarized word beginning. Predictive inference may thus facilitate even the earliest language development. Based on our results with 12-month-old subjects, it seems that predictive coding may also accelerate word recognition.

Reading Words When the Letters are Individually Rotated: An ERP Masked Priming Experiment

Manuel Perea¹, María Fernández-López¹, Ana Marcet¹, Marta Vergara-Martínez¹

¹ University of Valencia

Leading neural models of visual word recognition assume that letter rotation slows down the conversion of the visual input to a stable orthographic representation. For instance, the Local Combination Detectors [LCD] model (Dehaene et al., 2005) assumes that “letter detectors should be disrupted by rotation (>40°)”. In an unprimed lexical decision experiment with individually rotated letters (0°, 22.5°, 45°, 67.5°, 90°), Kim and Strakova (2012) found that the ERP component N170 amplitude and latency changed as a function of letter rotation. In addition, previous behavioral research has shown that rotated primes (90°) are as effective at activating word representations as vertical primes with upright letters (see Perea, Marcet, & Fernández-López, 2018).

To further check this assumption of the LCD model, we conducted a masked repetition priming lexical decision ERP experiment where we rotated the individual letters of the identity/unrelated primes (0°, 45°, and 90°). Targets were always presented in the standard horizontal format. We examined whether masked identity priming survived the rotation of *individual letters* within words by tracking the time course of the letter rotation effect in the N/P150 (encoding of size invariant visual features), N250 (mapping of letters onto whole-word representations), and N400 (mapping of whole-words onto semantic representations) ERP components. We employed a 3 x 2 within-participants design (Prime rotation: 0°, 45°, 90°; Prime: Identity, Unrelated).

Main effects of identity priming and letter rotation were obtained behaviorally. In the ERP analyses, amplitude comparisons revealed main effects of identity priming between 250-500ms, and main effects of letter rotation in the N/P150, N250, and N400. In the latency comparisons, the N/P150 and N400 were delayed as a function of letter rotation (Kim & Strakova, 2012). Thus, the processing cost of words preceded by rotated stimuli originates in the “visual feature encoding” stage. Furthermore, although the masked identity priming effect occurred in the three conditions, its size was smaller in the rotated conditions. In sum, the lack of a total disruption in masked identity priming effects for words with individually rotated primes poses problems for those models that assume that “letter detectors” are severely hindered by stimulus rotation during the initial moments of processing (LCDs model; Dehaene et al., 2005).

Reducing Noise in White Matter Reconstruction: Comparison of Correction Methods

Victor Karpychev¹, Olga Dragoy¹

¹ Higher School of Economics

Associative white matter pathways involve in speech processes by connecting areas of the cerebral cortex that are related to speech. Reconstruction of associative white matter pathways is nowadays often used in neuroscience research for a deeper understanding of speech processes, constrained spherical deconvolution (CSD) being one of the most modern and promising approaches. However, CSD is largely influenced by noises such as eddy currents, susceptibility-induced off-resonance field and subject motion. Two basic correction methods have been recently suggested: the field mapping approach realized through preprocessing of diffusion weighted images (DWI) acquired in opposite phase-encoding scanning directions (anterior-posterior (AP) and posterior-anterior (PA)), and the coregistration of structural images to DWIs acquired in the AP-direction only. The aim of this study was to compare these two competing correction methods.

DWI data were acquired from a healthy volunteer using the following parameters: 3T scanner, voxel size 2.5x2.5x2.5mm, FOV =240x240mm, 56 slices, 64 diffusion-weighted volumes and 2 non-diffusion-weighted volumes (b0), with AP-direction and PA-direction. According to the field mapping approach, DWIs were corrected by applying field mapping correction in the FSL software package (<https://fsl.fmrib.ox.ac.uk/fsl/fslwiki/FSL>). The coregistration method was implemented in the ExploreDTI software (<http://exploredti.com>). The corrected by the two methods data were further processed in the StarTrack package (<https://www.mr-startrack.com>) by applying the CSD damped Richardson-Lucy algorithm. Reconstruction of major associative pathways in both brain hemispheres was performed in TrackVis (<http://www.trackvis.org>); the two processing pipelines were compared based on micro- and macrometrics of the tracts.

The nonparametric Kruskal-Wallis test did not show significant difference between the two compared correction methods in any calculated white-matter metrics. Although the findings need to be replicated in a group study, we tentatively conclude that both methods are equally effective in preprocessing diffusion-weighted imaging data. However, taking into account that the co-registration approach is considerably less time- and computer power-consuming, it can be recommended as the preferred part of the DWI-pipeline.

Selective Auditory Attention During Naturalistic Audio-Visual Dialogues with Shuffled Lines

Patrik Wikman¹, Alina Leminen^{1,2}, Miika Leminen^{1,3}, Matti Laine⁴, Kimmo Alho¹

¹ Department of Psychology and Logopedics, University of Helsinki

² Cognitive Science, Department of Digital Humanities, University of Helsinki

³ Department of foniatics, Helsinki University Hospital

⁴ Department of Psychology, Åbo Akademi University

Humans can remarkably attend to a single speaker in the presence of irrelevant voices. Technical and theoretical advances have now enabled us to study the neural underpinnings of this capability using naturalistic stimuli. In our previous study (Leminen et al., in preparation), we used videos of dialogues between two speakers during functional magnetic resonance imaging (fMRI). The visual and auditory quality of the dialogues were modulated from good (i.e., fully comprehensible) to very poor (i.e., virtually incomprehensible). The participants had to either attend to the dialogues, or to ignore them and perform a visual control task. Selective attention to the dialogues increased activation in brain regions, previously associated with the control of top-down attention (inferior parietal lobule and inferior frontal gyrus). Interestingly, attention also modulated activations in medial parietal and frontal regions, previously associated with social cognition and emotional processing. This was rather unexpected, as the dialogues were intentionally created not to induce a strong socio-emotional context.

In the present fMRI study, we tested whether the medial frontal activations found in our previous study were due to each dialogue having a cohesive plot, which might have induced a strong enough social framework to automatically activate regions related to social cognition. We used the same tasks and dialogues as in our previous study, but shuffled the lines in half of the dialogues, thus breaking the plot of the dialogue. Our hypothesis was that shuffling would break the social context of the dialogues and, thus, silence regions related to social cognition, whilst keeping the effects related to auditory and visual quality and control of selective auditory attention intact. In contrast, if the shuffled videos are associated with similar medial activations as the non-shuffled videos, these regions might have a role in the allocation of attention in naturalistic settings.

The results showed similar activation patterns in relation to quality and attention. Also, in accordance with our hypothesis, there were stronger activations in medial frontal cortex during the shuffled dialogues in comparison to the normal dialogues, suggesting the medial frontal activations were related to the cohesiveness of the plot. Interestingly, there were also stronger STG activations suggesting that the plot of the dialogue modulates activations in regions associated with “low level speech processing”.

Sensorimotor Interactions During Shadowing of Natural Dialogues in fMRI

Artturi Ylinen¹, Patrik Wikman¹, Alina Leminen¹, Miika Leminen¹, Kimmo Alho¹

¹ University of Helsinki

In order to understand and produce speech, the sensory and motor systems of the brain interact. The involvement of the motor system in speech understanding has been debated in the context of the motor theory of speech perception (Liberman et al., 1967), and modern theories seem to agree that the auditory and motor systems significantly interact during speech production. As yet, however, there is no consensus on how essential this motor activation is for speech perception (e.g., Pulvermüller & Fadiga, 2010; Hickok & Poeppel, 2000), and whether it is task-dependent. Accumulating evidence suggests, however, that motor areas are activated in speech processing especially when the speech stimuli are degraded (e.g., Callan et al., 2010).

In the present study, we examined the sensorimotor interactions during different tasks when participants were presented with videos of natural dialogues between two speakers in fMRI. These dialogues were presented in combinations of two levels of auditory and visual quality (good, poor). There were four auditory tasks: a listening task, a shadowing task, a motor control task for shadowing, and an auditory detection task. In the listening task, the participants had to listen to the dialogues and answer related questions. In the shadowing task, the participants had to immediately repeat the speech of the same-sex speaker. In the auditory detection task, the participants had to count the occurrences of the phoneme [r] in the dialogue. Furthermore, there was a visual task in which participants counted the rotations of a fixation cross.

Preliminary results (N=4) showed activation in a Sylvian parietal temporal area (Spt) during the shadowing task as compared to the control task. This was expected, as area Spt is suggested to be involved in sensorimotor integration in speech (e.g. Hickok et al., 2009). The phonetic detection task, compared to the listening task, seemed to activate an area in the premotor cortex, supporting the idea that the motor areas are recruited when attention to phonetic details of the speech is required (e.g. Hickok & Poeppel, 2004, 2000). More participants are needed to say anything definitive about the activation modulations caused by the audiovisual qualities in the phonetic and shadowing tasks.

Speech and Gesture Disfluencies

Yulia Nikolaeva^{1,2}

¹ Moscow State University

² Institute for Linguistic Studies, RAS

In everyday communication, we often hear speech disfluencies (pauses, falstarts, hesitations, self-corrections). During the last decades we have known a lot about gestures accompanying speech, these two channels of communication being closely interlinked. So, we can expect similar phenomena in gesticulation too. While there are already many studies concerning speech disfluencies, the question of the specificity and the very existence of such gesture disfluencies is yet to be studied. In this study, using the material of the multimodal corpus “Stories and talks about pears” (www.multidiscourse.ru), we have compared irregularities in speech and gestures. By analogy with speech failures, gestural falstarts (unfinished gestures) and hesitations (decelerated preparation or retraction phases of gesture) were singled out. As speech disfluencies, strong and weak falstarts (Kibrik, Podlesskaya, 2006) and breaks of prosodic units caused by interference of other interlocutors were studied.

Although there is great variation between the speakers, one can notice some prominent patterns. While verbal failures occur much more often than gestures (about 6 times), they can be combined in different ways: about half of the gesture falstarts occur in the same EDU (elementary discursive units approximately corresponding to simple sentences) where there are speech failures. The fact that gestural and speech malfunctions occur independently but can be combined in one EDU suggests that these two channels of communication — verbal and gestural — are interrelated but have some autonomy.

Kibrik, A.A., Podlesskaya, V.I. (2006). The Problem of Segmentation of Oral Discourse and the Cognitive System of Speech: VD Soloviev (Ed.) Cognitive Studies, T. 1. M.: Institute of Psychology, Russian Academy of Sciences, 138-158

The research was carried out at the Institute of Linguistics of the Russian Academy of Sciences with the financial support of the RSF, grant No. 14-18-03819 “Language as it is: Russian multimodal discourse”.

Structural Characteristics of Oral Speech and Mental Condition

Viktor Balin¹, Mariya Kutsyreva¹

¹ Saint Petersburg State University

There is a need for methods that would allow to indicate psychological parameters in a “contactless” way, as a psychologist cannot always communicate with a subject (pilot, submariner, etc.).

The correlation between oral speech and mental state was studied in 86 psychology students aged 18-32. The text “My hobby” was recorded. Parameters: interview time, number and average size of sentences, number of parts of speech (19 indicators). Physiological parameters: α -ind. and EEG frequency; amplitude and frequency of α -rhythm; variance of R-R-intervals of ECG, pulse, pressure (PD, SDD), respiration (BR, VCL), strength and hand tremor (33 indicators). Subjects were split into 7 subgroups (s/g) based on empirical distribution of a trait using standard deviation (σ) in terms of: a) personal and b) situational anxiety; c) anxiety by Taylor. S/g 1 and 7 were cut off.

Structure of speech characteristics. There were 5 s/g for each of the 3 alarm scales. Pearson correlations for 19 parameters were considered. Only correlation matrices were studied.

Characteristics of the matrix: 1. number of significant correlations; 2. their sum; 3. module of average correlation; 4. sum of correlation modules; 5. sum of internal bonds (AIC=sum of significant correlations in the matrix/total sum of correlations in the matrix). All-in modules.

Structure of physiological indicators. Correlations between 33 indicators were considered.

The same matrix characteristics as for speech were studied for 15 matrices, for the same s/g 2-6.

It was shown that mental state is reflected in structure of speech. The most informative are indicators of AIC. They were averaged for the three methods; s/g 2: AIC=0.19; 3: AIC=0.3; 4: AIC=0.41; 5: AIC=0.35; 6: AIC=0.33. So, the initial increase in anxiety leads to an increase in correlations between speech parameters (AIC from 0.19 in the initial s/g 2 goes up to 0.3 in s/g 3 and increases to 0.41 in s/g 4). Level 4 is the inflection point of AIC dependence on alarm, then AIC decreases: in s/g 5 AIC=0.35, and in s/g 6 - 0.33, without falling to 0.19, as in s/g 2.

The average values of AIC physiological indicators: in s/g 2 AIC=0.22, in s/g 3=0.43, in 4=0.48, in 5=0.44, in 6=0.23. The inflection point is s/g 4. It can be concluded that the text structure changes in parallel with the change in the structure of physiological indicators. The mental state is related to how an oral statement is formed. This method can be referred to as “contactless”, since it requires no tests or physiological measurements.

The Development of Words and Sentences Processing: ERP Study in 9–13 Years Old Children

Elizaveta I. Galperina¹, Natalia V. Shemyakina¹, Zhanna V. Nagornova^{1,2},
Olga V. Kruchinina², Alexander N. Kornev¹

¹ Saint Petersburg State Pediatric Medical University

² Sechenov Institute of Evolutionary Physiology and Biochemistry of RAS

Brain base for the reading text processing has multilevel organization. Functional brain networks for the word decoding and for the sentence processing have distinct developmental milestones. The aim of the study was to evaluate the age-related features of the ERPs in a word and sentence processing.

Eighteen TD young (9–10 y.o.) and twelve elder children (12–13 y.o.) were EEG registered in two categorization task paradigms: 1) reading and categorizing meaningful /nonsense sentences presented in two steps — i) the contextual part of a sentence and ii) the key word presentation; 2) reading of 2 different sequentially presented words followed by the same/different word.

The comparison of the ERPs related to the reading of the last word in meaningful and nonsense sentences in elder group revealed the significant difference of P600 waves (620–708 ms) in frontal area and no significant distinctions in younger group. The between-group comparison has shown the largest N400 latency with the lowest amplitude in the old age group both in word processing and in sentence processing. In the meaningful sentences processing, the between-group difference was significant in the frontal areas (Fp2, F3, F4, Fz). In the words' pairs processing task, the age-related distinction was significant in case of the second identical word in T4 and in case of second different word in F3, C3, P3, Pz, T6 and O1.

Our results should be discussed from the perspective of the mastering the words and sentences processing skills in the age range of 9–13 years. The less N400 amplitude in the elder participants could be related to the less effortful processing of sentences and words stimuli. It could be explained by the development of the more specialized brain networks to enable the parallel mode of the text processing.

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The Dynamics of the Θ -Rhythm in the Process of the Chemistry Language System Formation

Dmitry Talantov¹, Elena Volkova¹

¹ Institute of Psychology of RAS

The main disadvantage of contemporary education is that the increasing complexity of cognitive activity leads to mental and physical exhaustion of students. Such exhaustion usually results in a decrease of α -rhythm and increase of Θ -rhythm. The objective of this study was to explore the dynamics of the Θ -band (4–8 Hz) power in respondents before and after the formation of the chemistry "linguistic" system.

We used the "Chemical differentiation" technique (Volkova, 2016) with simultaneous EEG recording (EEG_C3_O1, EEG_C4_O2 with sensitivity settings of 70 μ V / mm and a scanning speed of 30 mm/s). The recording of the EEG was automatically scanned for artifacts. The formulas of chemical compounds appeared on the screen in a random order. A participant's task was to divide these stimuli into a number of groups according to the instruction: into 2 groups (global level — simple and complex compounds), into 4 groups (basic level — oxides, acids, bases, salts), into 14 groups (detailed level — acid oxide, amphoteric oxide, basic oxide, etc.). The quantity (n) of errors, the reaction time (T, sec), and the measure of the complexity of chemistry linguistic system (quantity of levels) were estimated.

Twenty three students aged 19–22 years took part in the present study.

It should be noted that, despite the high motivation of the activity, psychology students have not been able to fully form the detailed level of chemistry language system (accuracy is less than 65%). It gives a decrease of the number of significant differences (T-test for dependent samples) in the power of Θ -rhythm between the detailed/basic (9 vs.6; 4–8 Hz vs. 4–6 Hz) and a detailed/global (17 vs. 6) levels.

When the global and basic levels of the chemistry linguistic system are formed (accuracy is more than 95%), significant differences in the power spectrum of the Θ -rhythm is not evident.

In this case, an increase in the cognitive complexity of information does not lead to exhaustion.

The research was carried out according to the state task of the Federal Agency of Scientific Organizations No. 0159-2018-0006.

The Effect of Seeing Written Word-Form on Spoken Foreign-Language Learning in Children

Katja Junttila¹, Anna-Riikka Smolander¹, Reima Karhila², Seppo Enarvi²,
Mikko Kurimo², Risto Näätänen^{1,3,4}, Sari Ylinen¹

¹ University of Helsinki

² Aalto University

³ Aarhus University

⁴ University of Tartu

For Finnish speakers without knowledge of English language, the written forms of English words do not convey how to pronounce them. Some written forms are misleading, like the word 'jet', which might be pronounced by a naïve Finnish speaker as /jet/ and confused with the word 'yet'.

Our study investigated how seeing a potentially misleading written word form affects the spoken foreign-word learning in children. Further, we investigated how the effects differ in children with dyslexia compared to typically reading children. We hypothesise that seeing the confusing written form of the word might hinder the learning of spoken words. Further, we hypothesise that children with dyslexia could be more affected because of their reading difficulties. The participants were 7-11-year-old monolingual Finnish-speaking typically reading children (n=34) and children with dyslexia (n=24). They rehearsed spoken English words with "Say it again, kid!" (SIK) computer game that is played by imitating the spoken English words heard in the game. The automatic speech recognition of the game gives the player feedback on the accuracy of their pronunciation. In the game, half of the participants only heard the spoken words and the other half both heard the spoken words and saw their written forms. Before and after playing the game, we recorded event-related potentials (ERP) while presenting the auditory standard word 'jet' and deviant word 'yet' in an oddball paradigm. We compared the ERP responses of the children who saw the written forms during the game to those of the children who only heard the spoken words.

The results show an increase in mismatch negativity (MMN) responses in typically reading children who saw the written forms while rehearsing, and in children with dyslexia who did not see the written forms. This suggests that typically reading children benefited from seeing the written form contrary to children with dyslexia whose learning was impeded by seeing the written form.

The Ratio of Participation of Sensory-Emotional Experience in the Concepts «Potential» and «Resources» in Students of Different Specializations

Natalia Volkova¹

¹ Institute of Psychology of the Russian Academy of Sciences

Our study aimed to reveal the differences of sensory-emotional features in the functioning of the concepts "resources" and "potential" depending on students' educational specialization. The study was conducted between 2015–2018 at the universities of Kostroma, Moscow, Penza and Taganrog. The study involved 209 volunteers of Primary Education, Foreign Languages and History faculties, aged 18-24 years (19,32 ± 1,48; 79,2% females). Statistical methods included Descriptive and Comparative Analysis (*Independent-Samples T-test*).

We used the «Semantic differential» method (modified by M. A. Kholodnaya) for assessing the degree to which sensory and emotional experiences were involved in functioning of the concepts.. Each concept was assessed with the use of 34 bipolar pairs of adjectives that allowed us to distinguish between sensory features (smooth – rough), emotionally-evaluative features (pleasant – disgusting), and spatiotemporal features (small – large). As a result, we obtained semantic profiles representing the sensory-emotive 'portrait' of each word in students of different specializations.

We have found significant differences between sensory, emotionally-evaluative and spatiotemporal features of the concepts "resources" and "potential" in students of various specializations. For example, students of the Primary Education Faculty (p≤0,000) are characterized by low indices of sensory-emotional features in the functioning of the concepts "resources" and "potential" in comparison with both students of Teacher of Foreign Languages (p≤0,05) Faculty and Teacher of History Faculty (p≤0,000). It should be noted that differences in the degree of expression of sensory-emotional features in the concepts "resources" and "potential" in groups of students at the Faculty of History and the Faculty of Foreign Languages are not so unambiguous. Namely, the concept "potential" was represented by a wider range of features (both sensory (p≤0,001) and spatiotemporal (p≤0,11)) compared to the concept "resources" (emotionally-evaluative features (p≤0,05)) in students of the Faculty of History.

The obtained data show that the amount of sensory-emotional experience in the concepts is variative and may correlate with both personal traits and peculiarities of professional education.

Theta-Oscillations in Developmental Dyslexia

Anna Petrova^{1,2}, Sam Po Law², Kai Yan Dustin Lau³, I-Fan Su²

¹ Higher School of Economics

² University of Hong Kong

³ Hong Kong Polytechnic University

Developmental dyslexia is characterized by deficits in speech processing, phonological and morphological awareness skills. The Lexical Quality hypothesis suggests that the lack of tight integration of orthography, phonology, and lexico-semantic information consequently leads to poor reading and comprehension. Recent studies suggested that theta frequency band is functionally related to early orthographic and phonological processing and retrieval of lexico-semantic information. But little is known about brain oscillation dynamics associated with reading in dyslexics.

In this study, we used event-related time-frequency analysis to investigate the awareness of morphological representations in dyslexics. Ten children diagnosed with developmental dyslexia (4 females, aged between 8.9 and 11.4 years old, $M = 10.1$, $SD = 0.83$, right-handed native Cantonese speakers) and ten children with normal neurological profile (2 females, aged between 9.2 and 10.1 years old, $M = 9.65$, $SD = 0.31$, right-handed native Cantonese speakers) took part in this study. Age-matched typically developing and dyslexic children were asked to verify whether a visually presented target word matched the preceding spoken word in a homophone verification task. The semantic congruency of the heterographic homophone pairs was manipulated.

Results showed that incongruent word pairs elicited greater theta power than congruent ones in the anterior regions. However, semantic congruency effects were only found in the control group, and absent in dyslexic readers. In addition, dyslexic children elicited larger theta power than controls over the whole scalp, particularly in the anterior left region.

In line with previous findings indicating the role of theta band in ambiguity resolution and early orthographic processing, we suggest that greater theta power reflects increased overall effort in lexical retrieval and semantic processing in dyslexia. Furthermore, the lack of congruency effects in dyslexic readers may suggest a weak integration between orthographic form, lexical semantic functional networks and working memory.

Written Text Processing Strategies in Young Adults: The Eye-Tracking Study of Good and Poor Comprehenders

Sergey Oganov¹, Alexandr Kornev¹

Saint Petersburg State Pediatric Medical University¹

Adults with both sufficient language and intelligence development, however, demonstrate a great individual variability in reading comprehension skills. Within the whole population, the subjects scored the bottom 15 percentiles according to the results of text comprehension tests are recognized as so-called poor comprehenders (Keenan, Meenan, 2014). Following some evidences, the text processing strategy manifested in oculomotor behavior may distinguish the good and poor comprehenders (Romero, Good, 2006). The aim of the current study was psychological and the eye-tracking analysis of the young adults' gaze movements during scientific text reading.

Two groups of young adults were composed for the eye-tracking study. The experimental group consisted of 16 poor comprehenders (PCs) scored ≤ 15 percentile for the text reading and comprehension test; the control group consisted of 18 good comprehenders (GCs) scored ≥ 85 percentile for the same test. During individual sessions, two scientific expository texts were presented for a self-pace reading and answering 10 comprehension questions (CQs) presented in two modes: 1) the CQs appeared both before and after the text reading; and 2) the CQs appeared only after the text reading. The gaze movements were processed by the eye-tracker SMI RED500.

Most of the subjects read the texts twice: during the 1st reading, all of them read the entire text; during the 2nd reading, the GCs mostly read selectively only some of its fragments, while the PCs read the whole text again. During the 2nd reading, the GCs produced less fixations ($p < 0.05$) and less progressive ($p < 0.05$) and regressive ($p < 0.05$) saccades in comparison to the 1st reading. The PCs, on the contrary, produced more fixations ($p < 0.001$) and more progressive ($p < 0.001$) and regressive ($p < 0.001$) saccades during the 2nd reading independently of the task presentation mode. Comparative analysis between the task modes revealed that in the mode 1, the GCs produced less progressive saccades ($p < 0.05$) than in the mode 2; while the PCs produced longer (in duration) progressive ($p < 0.01$) and regressive ($p < 0.05$) saccades.

Our results evidenced that good and poor comprehenders tend to employ different cognitive strategies for the printed text processing. It should be reasonable to suppose that the PCs are less skilled in self-monitoring of text comprehension and less flexible in switching between strategies according to the task presentation mode.

Psychophysiological Patterns of Native and Non-Native Language Perception in Young Children Raised in Institutions

Maxim Petrov¹, Anna Luchina¹, Irina Ovchinnikova¹, Marina Zhukova¹,
Irina Golovanova¹, Olga Titova¹, Sergey Kornilov^{2,3,4}, Elena Grigorenko^{1,2,3,4,5}

¹ Saint Petersburg State University

² University of Houston

³ Baylor College of Medicine

⁴ Haskins Laboratories

⁵ Yale University

Speech perception and understanding of the features of the native language compose the most crucial steps in speech and language development at early stages, but the mechanisms underlying these processes are largely unknown. Studying these processes in young children with a history of institutionalization is informative, as children residing in institutional care tend to have severe lags in speech development. The aim of the present study was to evaluate the distinction of native and non-native phonological contrasts in young children brought up in baby homes and biological families.

The sample consisted of 31 children (14 females, $M = 17.3 \pm 2.6$ months) from baby-homes, and 39 children (17 females, $M = 17.8 \pm 2.7$ months) from biological families. A double-oddball paradigm (Näätänen, 1992; Mismatch Negativity, MMN) with three consonant-vowel syllables was used. The phoneme /d/ in syllable /du:/ was common to both Russian and Hindi languages and was used as the standard. Two language-specific sounds served as deviants: phoneme /g/ in syllable /gu:/ was deviant for Russian language (Deviant Native), phoneme /d/ in syllable /du:/ was deviant for Hindi language (Deviant Hindi). Deviants appeared in a semirandom sequence in a 80/10/10 presentation proportion (1200/150/150 trials) with at least three standards shown between deviants. MMN was recorded within 100-300 ms time window and was calculated as the difference between ERPs for the common and each deviant type.

The MMN component was not observed in any of the groups when a Deviant Hindi was presented. The MMN was recorded with high probability in both groups for deviant Native. The MMN component in both groups was noticed in the frontal (midline frontal, M-F) and in the central (midline central, M-C) electrode clusters in the 100–300 ms time window. No significant differences were observed for the amplitudes of average ERPs for the Standard and Deviant Native in the M-F and M-C electrode clusters ($F(1, 270) = 0.287$, $p = 0.592$) between both groups. Moreover, there were no significant group differences between peak amplitude

and peak latency of MMN component elicited by Standard and Deviant Native phonological contrast.

The results of the study suggest that even though children raised in baby homes tend to have atypical language perception, it does not affect their ability to phonetically distinct sounds of their native language. So, the delay of phonetic development could not be the reason of speech and language impairments observed in children reared in institutions.

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The Effect of Verbalization on the Unfolding of Imagery Components in Abstract and Concrete Concepts

Nadezhda Novikovskaya¹, Olga Shcherbakova¹

¹ Saint Petersburg State University

Intelligence is based on one's conceptual framework. This framework is a hierarchy of various cognitive structures represented by imagery and verbal components of the cognitive system (Kholodnaya, 2012). Although there are many studies, which reveal the connection between verbal and imagery components of thinking and cognitive functions, the extent to which verbal and imagery cognitive systems are related to one another remains unknown (Paivio, 1965; Vekker, 2001).

This study (n = 61, 41 females, aged 18 – 25, mean age – 20 y.o.) aimed to reveal the role that verbal structures play in actualization of the imagery representations of concepts. We used “Pictograms” (modified version) as a main research tool. We predicted that a) giving verbal definition for a concept will improve the quality of its imagery representation; b) quality of the written verbalization of the concept correlates with quality of its imagery representation; c) actualization of the main features of imagery and verbal components of the concept correlates with its abstractness/concreteness.

We did not find any significant differences in the quality of imagery representations between

participants who gave verbal definitions for concepts and participants who did not. Our prediction concerning the correlation between the quality of written verbalization of the concept and quality of its imagery representation was supported ($p < 0,01$; $r = 0,516$). We found significant differences in the quality of imagery representations and written verbalizations between concrete and abstract concepts ($p < 0,01$). The quality of actualization of the main features of concrete concepts was lower ($x = 0.365$) than the quality of actualization of the main features of abstract concepts ($x = 0.522$). Also, the qualitative analysis revealed different strategies of concepts' depicting. These variances were due to individual patterns of mental operations between the respondents.

The results suggest that a highly developed conceptual system provides the full functioning of both image and verbal systems for constructing mental representations of concepts (Vekker, 2001; Kholodnaya, 2012). In addition, it appears that understanding the meaning of concrete concepts is associated with their frequent actualization in everyday context, which requires considerable cognitive effort to find the abstract meaning of concrete concepts (Polyakov, 2011).

Memories about Childhood: Family Transmission of Narrative Structure in Uzbekistanis and Russians

Julia Zaitseva¹, Anastasia Lyamsenko¹

¹ Saint Petersburg State University

How do family and cultural discourses construct the way people remember their childhood? Sharing the childhood memories with one's own children is a part of a family intergenerational transmission of values (Fivush, 2001; McAdams, 2001). Being a part of the life script, childhood provides a person with self-defining memories culturally shared in the cohort. Personal self-defining memories, as well as the vicarious ones (Thomsen, Pillemer, 2017) of their important others, form the narrative identity. The narrative structure of the stories frames the experience. Constantly repeated cognitive schema can form a personality with mostly positive or negative memories (McAdams, 2001), integrated or discounted (Singer et al., 2013; Zaitseva, 2016), with proactive or reactive image of the protagonist (Trzebiński, 2001) concerned about a communion or agency issues (McAdams, 2001, Hermans, 1995). Could the parents transmit the narrative structure to their children as well as the content of their stories, providing the cultural instrument for autobiographical reasoning and identity processes?

We chose a cross-cultural experimental design modeling the process of the intergenerational family transmission. Three cultural groups of young adults (18-25 years old, N=74) and their parents (40-60 years old, N=34): Russians from St. Petersburg and Moscow (N=43; 10 family dyads); Russians who have been residents of Tashkent (Uzbekistan) for a long time (N=51; 10 dyads); Uzbekistanis from Tashkent (N=54; 12 dyads). We asked participants to recall two stories about their childhood and tell these stories to the experimenter. Then parents shared their stories with their children. In a week, children came back and retold parents' stories to the experimenter. We compared the narrative structure of all the stories in different cultural groups.

The most typical narrative schema of childhood memories was proactive (starting with intention) and positive (happy end). Agency theme was more frequent among those who lived in Russia ($p=0,036$; $\chi^2=4,3$). Parents' stories were more often integrated ($p=0,005$). Uzbekistanis and Russians in Tashkent retold parents' stories with concordant narrative structure, Russians in Russia with a changed one. In the retold stories, the changes that appeared the most often, were 1) defensive type reinterpreted into proactive one; 2) a positive integration was emphasized. Gender correspondence in dyads and novelty of the stories factors did not alter the results.

Cultural specific of Uzbekistani discourse (traditional and collective) affected the family transmission of the childhood memories narrative structure.

Comprehension of Texts' Metaphorical Meanings, Emotional Intelligence and Theory of Mind: Is There a Correlation?

Iunna Golshtein¹, Olga Shcherbakova¹

¹ Saint Petersburg State University

The ability to understand metaphorical meaning of a text is one of the core features of abstract thinking and language comprehension (Van Dijk, Kintsch, 1983; Graesser et al., 1997). Despite the crucial role this ability plays in our intellectual life, underpinning cognitive mechanisms are still elusive. Here, we predicted that emotional intelligence (EQ) and theory of mind (ToM) contribute to the depth of comprehension of texts' metaphorical meanings.

Our study (N = 30; 73,3 % female; aged 18 – 31) consisted of 4 stages:

- 1) psychometric intelligence (IQ) level control (J. Raven's "Standard Progressive Matrices");
- 2) EQ level assessment (D.V. Lyusin's "Emotional Intelligence Questionnaire");
- 3) assessment of the depth of comprehension of texts' metaphorical meanings using semi-structured in-depth interview (Shcherbakova, Nikiforova, 2018). Participants were presented with 3 sets of fables, 3 fables each, and asked to interpret each fable and then pair any 2 fables within each set. Each interpretation was scored 0 (literal), 1 (common sense) or 2 (highly generalized). Each pairing was scored 0, 1 or 2 depending on whether it was based on fables' gists or not;
- 4) ToM level assessment (S. Baron-Cohen's "Reading the Mind in the Eyes" test, adapted by E.E. Rumyantseva, 2016).

Correlation (depth of comprehension*EQ: $r = -0,24$; $p > 0,05$; depth of comprehension*ToM: $r = -0,30$; $p > 0,05$; pairing*EQ: $r = -0,30$; $p > 0,05$; pairing*ToM: $r = 0,05$; $p > 0,05$) and regression analyzes did not reveal any correlations between all 4 parameters. Variance analysis showed that EQ level in participants with common sense fables' comprehension was lower than EQ level in participants with literal and highly generalized fables' comprehension ($F = 4,159$; $p = 0,027$; $t = -2,866$; $p = 0,008$). We found no differences in EQ ($t = -0,150$; $p > 0,05$) and ToM ($F = 0,195$; $p > 0,05$) between groups of participants with low and high levels of fables comprehension.

The obtained results did not reveal any linear correlations between comprehension of texts' metaphorical meanings, EQ, and ToM. We interpreted this in a way that the comprehension of texts' metaphorical meaning is an independent psychological construct which requires its own cognitive mechanisms and cannot be explained by other psychological constructs, including EQ or ToM.

Metaphor as a Way to Study Implicit Concepts (on Example of "Curiosity" Concept)

Marina Avanesyan¹, Iana Bashmakova¹

¹ Saint Petersburg State University

A large number of studies suggests the body-grounded nature of cognition. This kind of experience is difficult to convey verbally, because it contains many implicit compounds. Metaphor is known as a verbal "envelope" for blended mental spaces associated with its concepts (topic and vehicle). That is why we used metaphors as a tool to define the internal representation of the concept "curiosity." Curiosity is often defined as the driving force of development and learning, conditioned by inner motivation. However, despite the role of internal motivation in curiosity, the subject's concept of curiosity has rarely been considered in previous research.

The sample included 45 students of St. Petersburg State University, aged 18 to 28 ($M = 20.14$ years). In the first task, they were asked to name an unlimited number of features of "curiosity" (explicit concept). In the second task, they were asked to create a metaphorical comparison of curiosity: "What is it like?" (implicit concept).

Metaphors made it possible to identify the motor patterns underlying the concept "curiosity". There is primarily a theme of penetration from the outside into an object (look in, poke through, soak through), as well as contact with something, transition from one thing to another, opening something. Metaphorical comparisons involved many descriptions of animals, most of which were small, nimble, capable of getting into inaccessible places ("The little nimble animal"). The ability to infiltrate various kinds of inaccessible spaces was conveyed through other images: "Color paint, that was dropped into a glass of water, trying to take up as much [space] as possible", "An instrument that squeezes into the crack and spreads it to become a portal / hole". The object of curiosity was often viewed as unavailable: "Box with opaque walls", "What's behind the closed door", "Sunny bunny, seeking to illuminate the unexplored surfaces of the room", "The plant that grows in the shadow of another and tries to reach the sun".

We took different metaphors to show the difference between explicit and metaphorical ideas about curiosity. The first ones were more stereotyped: curiosity is socially unacceptable to manifest, but it is experienced as a pleasant emotional state, interest and vitality when interacting with the world. Implicitly, curiosity appears as more uncontrollable but capable of acquiring usually unattainable object and is connected with certain motor patterns and kinesthetic senses.

Cathodal tDCS of Wernicke's Area Affects Online Acquisition of Novel Word Meaning

Daria Gnedykh¹, Nadezhda Mkrtychian¹, Diana Kurmakaeva¹,
Evgenii Blagoveschenskii¹, Svetlana Kostromina¹, Yury Shtyrov^{1,2}

¹ Saint Petersburg University

² Aarhus University

The available evidence with respect to the mechanisms underpinning acquisition of novel surface forms and single-word semantics remains contradictory.

To address this, cathodal tDCS over Wernicke's area was applied during contextual acquisition of new concrete and abstract words. Learning outcomes were assessed using lexical decision tasks both immediately after the tDCS/learning session and on the next day.

Novel items were created by modifying existing words in participants' native language (Russian) to produce a lexical competition effect (e.g. *garderob***garderin*), and were rotated across following conditions: new abstract words, new concrete words, lexical neighbours/competitors and unrelated fillers. Stimuli were grouped into sets of 10, matched on their lemma and final syllable frequency, and rotated across conditions. Acquisition of new word forms and their novel meanings was achieved by written word-by-word presentation of 5 sentences describing situations through which the participant could deduce the meaning of novel words. The length of the sentences and number of words were balanced; novel words were presented in their base form at the end of the sentences.

Two groups, with 24 healthy monolingual Russian speakers in each (age 17–35), received either cathodal or sham (placebo) tDCS over Wernicke's area for 15 minutes before the behavioural learning session. Wilcoxon Test was used to analyse the results of behavioural data (reaction times and accuracy scores).

On Day 1, the lexical decision task showed better accuracy in the cathodal than the sham group for responding to pseudoword competitors of novel abstract words ($p \leq 0.015$). On Day 2, for both sham and cathodal tDCS, the scores were lower and latencies longer for novel abstract and concrete words than for existing competitor words (all p -values ≤ 0.04). These findings suggest that cathodal tDCS over Wernicke's area, in comparison to sham stimulation, reduces lexical competition for novel words, which can be interpreted as a sign of reduced integration of these novel items into the mental lexicon. This effect is most pronounced for abstract words, highlighting Wernicke's area role in acquiring abstract semantics. Future research of tDCS effects on language learning could lead to development of neurostimulation protocols for clinical and educational applications.

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