The 10th Annual Embodied and Situated Language Processing

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ESLP 2017 is hosted by the Centre for Cognition & Decision Making, the National Research University Higher School of Economics (http://www.hse.ru/en/cdm-centre).

The general topic of this Anniversary edition of ESLP is *Interdisciplinary Approaches to Embodied and Situated Cognition.* ESLP 2017 will showcase new theoretical and empirical research by individuals and groups who transcend traditional research fields' boundaries and combine research methodologies in their investigations of embodied and situated nature of linguistic and conceptual knowledge.

Keynote speakers:

Michael Arbib, *University of Southern California, USA*

Lawrence Barsalou, *University of Glasgow, UK*

Lera Boroditsky, *UC San Diego, USA*

Luciano Fadiga, *University of Ferrara, Italy*

Pia Knoeferle, *Humboldt University of Berlin, Germany*

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PROGRAMME

Time	Speaker	Title
Session 1: Sunday, 10 September		
Auditorium		
Armyanskiy per. 4		
Time	**Speaker**	**Title**
9:00 – 9:30	Vasily Klucharev	WELCOME AND INTRODUCTION
9:30 – 10:30	**Pia Knoeferle**	**What guides situating language processing?**
10:30 – 11:00	COFFEE BREAK	
11:00 – 11:30	Dato Abashidze, Pia Knoeferle	Actor gaze and action mismatches during language processing
11:30 – 12:00	Olga Dragoy, Anna Chrabaszcz, Anna Laurinavichyute, Nina Ladinskaya, Valeria Tolkacheva, Andriy Myachykov	Oculomotor resonance during processing past and future tense
12:00 – 12:30	Katja Münster, Pia Knoeferle	The effect of speaker facial expression and listener mimicry on emotional sentence processing
12:30 – 13:00	Julia Marina Kroeger, Katja Münster, Pia Knoeferle	Do Prosody and Case Marking influence Thematic Role Assignment in Ambiguous Action Scenes?
13:00 – 13:30	Elli Tourtouri, Francesca Delogu, Matthew Crocker	The interplay of specificity and referential entropy reduction in situated communication
13:30 – 14:30	LUNCH	
14:30 –15:30	**Lawrence Barsalou**	**What does semantic tiling of the cortex tell us about semantics?**
15:30 – 16:00	Richard Shillcock	A Materialist Understanding of Spoken Language Development and Functioning

16:00 – 16:30	Elena Kulkova, Yury Shtyrov, Matteo Feurra, Andriy Myachykov	Idiom sentence processing elicits larger excitation in M1, compared to metaphor sentence processing
16:30 – 17:00	Valeriia Perepelytsia	Language Networks on Molecular Level
17:00 – 17:30	COFFEE BREAK	
17:30 – 18:00	Christoph Scheepers, Sophie Messner, Ben Dunn	The Crossword Effect: A retrieval advantage for words encoded in line with their spatial association
18:00 – 18:30	Pawel Sickinger	Exploring the conceptual basis of multilingual language processing
18:30 – 20:00	RECEPTION AND POSTER SESSION 1 *Auditorium*	

Session 2: Monday, 11 September		
Auditorium		
Armyanskiy per. 4		
Time	**Speaker**	**Title**
9:00 – 9:30	Maria Yudkevich	WELCOME AND INTRODUCTION
9:30 – 10:30	**Luciano Fadiga**	**The syntactic brain**
10:30 – 11:00	COFFEE BREAK	
11:00 – 11:30	Hamutal Kreiner	Prosodic temporal patterns as an embodiment of syntax
11:30 – 12:00	Tatjana Nazir	Embodiment of Literature: EGG while listening to book excerpts distinguishes between fiction and documentation
12:00 – 12:30	Thomas Kluth, Michele Burigo, Holger Schultheis, Pia Knoeferle	Size Matters: Effects of Relative Distance on the Acceptability of Spatial Prepositions
12:30 – 13:00	Natalia Zaitseva, Dmitry Zaitsev	Language Acquisition, Simulation and Phenomenology
13:00 – 14:30	LUNCH POSTER SESSION 2 Auditorium	
14:30 –15:30	**Michael Arbib**	**Constructing a construction grammar adequate for modeling the language-ready brain**
15:30 – 16:00	Natalie Kacinik	Large ants and small mansions: To what extent do perceptual manipulations affect word processing?
16:00 – 16:30	Marina Shkuropackaya	Secondary nomination in Mongolian and Russian language picture of the world (based on zoonyms)

16:30 – 17:00	Elena Nekrasova	«Modality in modality». Audiovisual perception of words with audiovisual semantics.
17:00 – 17:30	COFFEE BREAK	
17:30 – 18:00	Claudia Mazzuca, Luisa Lugli, Roberto Nicoletti, Anna M. Borghi	Abstract, Emotional and Concrete Concepts and the activation of mouth-hand effectors
18:00 – 18:30	Ladislas Nalborczyk, Marcela Perrone-Bertolotti, Céline Baeyens, Romain Grandchamp, Elsa Spinelli, Ernst Koster, Hélène Lœvenbruck	Verbal rumination as simulated speech
18:30 – 20:00	DINNER AND BOAT TRIP	

Session 3: Tuesday, 12 September		
Auditorium		
Armyanskiy per. 4		
Time	**Speaker**	**Title**
10:00 –11:00	**Lera Boroditsky**	**How languages help us construct and construe events**
10:30 – 11:00	COFFEE BREAK	
11:00 – 11:30	Andrej Kibrik, Olga Fedorova, Alla Litvinenko, Julia Nikolaeva	An empirical study of multichannel communication
11:30 – 12:00	Bo Yao	"She sells seashells": Direct speech quotations promote tongue-twister effects in silent reading
12:00 – 12:30	Lawrence Taylor	Dissociation between action and motion verbs: Evidence from stroke
12:30 – 13:00	Markus Ostarek, Jeroen van Paridon, Samuel Evans, Falk Huettig	Conceptual processing of up/down words (cloud/grass) recruits cortical oculomotor areas
13:00 – 13:30	Nikola Vukovic, Torben Lund, Brian Hansen, Sune Jespersen, Yury Shtyrov	Primary Motor Cortex is Involved in Online Word Learning: A Continuous Theta Burst TMS Study
13:30 – 14:30	Vladimir Glebkin, Nikita Safronov, Varvara Sonina	Discourse acquisition by Russian preschool-aged children: The case of pear film retelling
14:30 – 15:00	CLOSING REMARKS	
15:00 – 18:00	MOSCOW TOUR	

KEYNOTE PRESENTATIONS

What guides situating language processing?

Pia Knoeferle

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Situated language processing research has examined the effects of rich contextual information (e.g., of world knowledge and of event depictions) on sentence processing using eye movements in scenes and event-related brain potentials (ERPs). From this research we have learned that all sorts of cues, including rich visual contexts, rapidly inform (expectations in) language comprehension. However, what guides (such context effects on) situated language processing is unclear. I will discuss cognitive biases as one important factor in the causality underlying situated language processing (i.e., the causal relations between language processing, visual attention to objects and events, brain responses, and associated cognitive states) and review first studies that have begun to provide insights into both such causality and cognitive biases.

What does semantic tiling of the cortex tell us about semantics?

Lawrence W. Barsalou

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Recent use of voxel-wise modeling in cognitive neuroscience suggests that semantic maps tile the cortex. Although this impressive research establishes distributed cortical areas active during the conceptual processing that underlies semantics, it tells us little about the nature of this processing. While mapping concepts between Marr's computational and implementation levels to support neural decoding, this approach ignores Marr's algorithmic level, central for understanding the mechanisms that implement cognition, in general, and conceptual processing, in particular. Following decades of research in cognitive science and neuroscience, what do we know so far about the mechanisms that implement conceptual processing? Most basically, much is known about the mechanisms associated with: (1) features and frame structure, (2) grounded, abstract, and linguistic representations, (3) knowledge-based inference, (4) concept composition, and (5) conceptual flexibility. Rather than explaining these fundamental conceptual processes, semantic tiles simply provide a trace of their activity over a relatively short time within a specific context. Establishing the mechanisms that implement conceptual processing in the brain will require more than mapping it to cortical (and sub-cortical) activity, with process models from cognitive science likely to play central roles in specifying mechanisms at the algorithmic level.

How languages help us construct and construe events.

Lera Boroditsky

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Languages differ in how they describe events. Further, within any given language, options for describing a particular physical event are often myriad. In this talk I will give some examples of how languages help us construct and construe physical reality, parceling up the stream of experience into units, assigning agents, endpoints, and adding information about intention and completion. These features of language guide how speakers of different languages attend to, remember and reason about events. I will also describe work with bilinguals, asking how influences from multiple languages mix in one mind. Do bilinguals perceive events with a cognitive "accent" inherited from the other languages they speak?

The syntactic brain

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My contribution will focus on the discussion of new hypotheses about a possible sensorimotor origin of language. In fact, although ideas that language and action could share some common neural substrates have been formulated by many and for a long time, they are usually referring to the similarity between motor planning and syntactic linguistic structures. I believe instead, and in this sense I will present some recent empirical evidence, that the similarity should be sought in the hierarchical structure and in the generalization ability that characterize the structural/functional organization of the motor system. So no planning (software) but computational potentialities of a sensorimotor structure (hardware) that has undergone a developmental soaring because of the evolution of the new capacity (starting in primates and exploding in man) of directly controlling individual spinal motoneurons. This direct control frees, on one side, the brain from the rigidity of spinal and subcortical motor synergies but, on the other side, imposes an exponential increase in computational complexity which could be recycled for cognitive purposes as well. It appears of particular interest in this regard the role of Broca's region, traditionally considered as the frontal center for speech production, but more and more considered as a venue for common syntactic processing in both action and language domains.

Constructing a construction grammar adequate for modeling the language-ready brain

Michael A. Arbib

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As part of a long-standing effort to understand the evolution of the language-ready brain (Arbib, 2016; Arbib & Rizzolatti, 1997), I have sought to better characterize what it is that evolved – namely, the brain mechanisms that support the use of language by modern humans. In particular, the aim is to understand the mechanisms linking perception, action and language. An entry point into the study of grammar seems needed for this purpose, and I have sought to bridge between brain theory (Arbib & Bonaiuto, 2016) and construction grammar (Croft, 2001; Goldberg, 2013) in this quest. Unfortunately, even computational construction grammars comes in diverse forms and so this raises the question: What can each version contribute to the eventual emergence of a Neural Construction Grammar (NCG) whose computations are linked to those for perception and action in a neurally plausible way to form an integrated model NCG++ of the larger system, and what gaps remain to be filled? This talk will report on the progress in performing this analysis with four colleagues who are experts in Dynamic Construction Grammar (DCG, Peter Ford Dominey), Embodied Construction Grammar (ECG, Nancy Chang), Fluid Construction Grammar (FCG, Michael Spranger) and Template Construction Grammar (TCG, Victor Barrès) with, as stated above, concern for how grammar links to interaction with the external world. A word of caution, though – although all humans rest their use of language on a brain within a human body, I think it is misleading to say that all language is embodied. Rather, the issue, I suggest, is to ask how evolution and embodiment provide an embodied core from which abstraction could emerge (Arbib, Gasser, & Barrès, 2014)."

ORAL PRESENTATIONS

Actor gaze and action mismatches during language processing

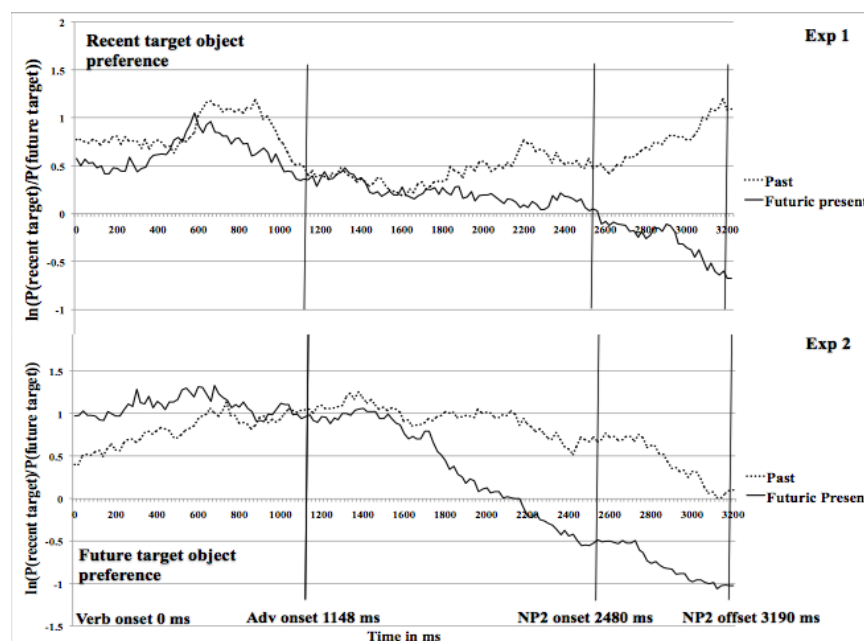Dato Abashidze, Pia Knoeferle

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Eye-tracking studies suggest that people rely more on a recent event than on a plausible future event during spoken sentence processing. Participants saw an action event and then they listened to an NP1-Verb-Adv-NP2 sentence either in past or futuric present tense. They preferentially inspected the recent event target over another plausible target object (that might be involved in a future action) independent of tense.

Two experiments (each N=32) tested this preference by introducing incongruence. In Experiment 1 the past tense verb mismatched the recently-seen action and in Experiment 2 the past tense sentences were accompanied by a mismatching actor gaze (to the future target object from verb onset). By contrast, the future sentences contained no mismatches. Can verb-action and gaze-sentence mismatches eliminate the recent-event preference? Would participants recall information in post- experimental memory tests better for matches (future) than mismatches (past tense)? The experiment contained an equal number of future and recent events as well as of sentences referring to past and to future action events.

Consistent with previous findings participants preferred to inspect the recent event target until the beginning of NP2 (Exp 1) / the end of the Adverb (Exp 2). Crucially, the incongruence increased the probability of comprehenders predicting the plausible future event target. Furthermore, gaze (but not verb-action) incongruence eliminated the overall recent event preference for NP2. The memory tests also showed evidence for a reversal of the recent-event preference.

Keywords: incongruence, gaze cue, language, event, eye tracking.

Oculomotor resonance during processing past and future tense

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Previous research (Boroditsky, Fuhrman, & McCormick, 2011) has shown that speakers of languages with left-to-right writing systems map time on the left-to-right axes, with earlier events mapped on the left. In this study, we tested spatial biases in processing linguistically encoded time - past and future tensed verbs.

Sixty-two native speakers of Russian, a language written from left to right, participated in an eye-tracking experiment. After looking at a fixation cross in the middle of the screen, a participant heard a verb (either in the past or the future tense) or a filler noun. Two seconds after the word onset, a visual spatial probe appeared in one of the five locations: center, left, right, top, or bottom of the screen. The participant had to press one of the five corresponding buttons on the gamepad to indicate the location of the spatial probe.

The gaze coordinates during 600 ms after the verb form's uniqueness point were aggregated into 50ms timebins over subjects and items. The resulting data were analyzed using mixed-effects linear models with main effects for verb tense, time (as measured in bins), and the interaction between them. A significant main effect of verb tense for the x axis was found: gaze coordinates were shifted to the left for past in comparison to future word forms (Est.=-0.29, SE=0.13, t=-2.3). No significant effects on the y axis and regarding the spatial probe task were found.

The results provide evidence for oculomotor resonance during processing temporal semantics expressed through tensed verb forms.
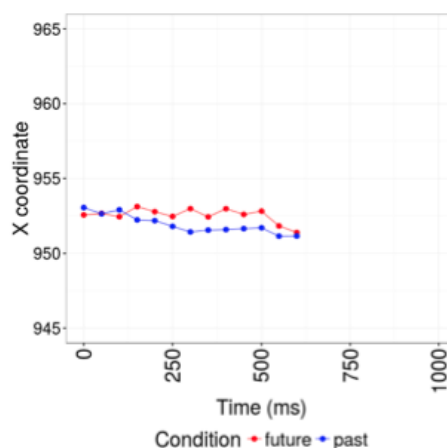
Keywords: tense, spatial mapping, eye-tracking

Figure 1. Ocular drift associated with processing past and future tense.

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The effect of speaker facial expression and listener mimicry on emotional sentence processing

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Using eye-tracking, we investigated whether congruent emotional facial expressions of speaker and hearer can facilitate a hearer's processing of a speaker's emotional utterances. In one half of the experiment, participants were instructed to hold a pen between their teeth, i.e., activating facial smiling muscles, while in the other half participants held the pen only using their lips, i.e., activating frowning muscles. In each trial, participants first inspected a video of a speaker's face, which was either emotionally positive or negative and thus (mis)matching in valence with participant's own facial expression. Subsequently, participants encountered a scene with 3 characters (i.e., frowning potential agent - neutral patient - smiling potential agent) and listened to a non-canonical positively valenced German object-verb-subject sentence describing an action between the smiling agent and the patient in a who-does-what-to-whom fashion (see Fig. 1). Participants' task was to decide if the speaker's face matches the positive valence of the sentence.

Eye-movement results yielded a marginally significant interaction between speaker and hearer facial expression in the verb region for female participants only. Against our expectations, women fixated the smiling agent prior to its mention in the sentence more when their own facial expression was incongruent (vs. congruent) with the speaker's facial expression. Moreover, all participants were significantly more accurate in deciding that the speaker's facial expression mismatches (vs. matches) with the valence of the sentence.

Keywords: real-time language processing, eye-tracking, emotional facial expressions, emotion simulation, speaker-hearer interaction
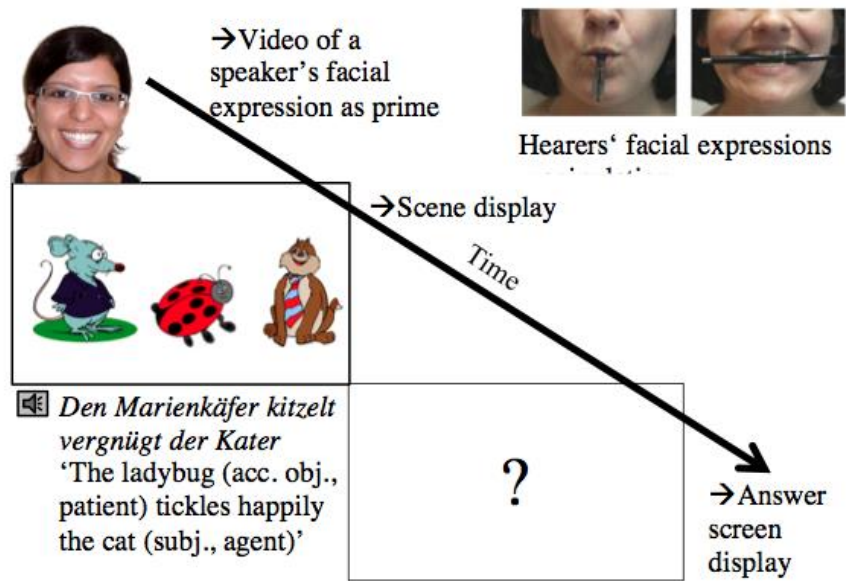
Figure 1. Experimental procedure. Note that the critical character is the smiling cat in this trial. Participants decided if the speaker's facial expression matches the valence of the sentence via button-press upon encountering the question mark.

Do Prosody and Case Marking influence Thematic Role Assignment in Ambiguous Action Scenes?

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Using eye tracking, we investigated whether five-year old children and adults can rapidly recruit prosody and\or case marking for thematic role assignment in scenes that ambiguously depicted role relations. We manipulated sentence structure and prosody. In Experiments 1a, 1b, and 2a (each N=24), case marking in SVO and OVS sentences was unambiguous; in Experiment 2b (N=22) critical sentences all had OVS order and case marking was either unambiguous or ambiguous. We emulated SVO and OVS biasing prosodic contours (Weber et al., 2006) adding neutral prosody as baseline (Exp. 1a and 1b). In Experiments 2a and 2b sentences either had an SVO- or an OVS-biasing prosodic contour. The scenes depicted clipart animals as performing identical actions (Fig. 1), thus providing a context without disambiguating thematic role relations.

Prosody had no clear effects on thematic role assignment but adults rapidly exploited case marking to predict thematic roles from the sentential verb region (Exp. 1a and 2a) and accordingly looked more to the object/patient-character in SVO sentences and the subject/agent-character in OVS sentences. When case marking was ambiguous, adults initially interpreted OVS sentences as agent-first (vs. patient-first) sentences (Exp. 2b). Children looked more towards the patient in all conditions (Exp. 1b; intercept $p < .05$). They mistakenly interpreted SVO sentences as agent-first sentences (SVO interpretation).

Keywords: Sentence Processing, Eye tracking, Prosody, Age differences, Thematic Role Assignment

Figure 1. Example of a scene.

German original - SVO: *Der Kater kitzelt gerade den Adler.* Literally: 'The cat (agent) tickles currently the eagle (patient).' German original - OVS: *Den Kater kitzelt gerade der Hamster.* Literally: 'The cat (patient) tickles currently the hamster (agent).' German original – OVS ambiguous: *Die Katze kitzelt gerade der Hamster.* Literally: 'The cat (amb. patient) tickles currently the hamster (agent).'

The interplay of specificity and referential entropy reduction in situated communication

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In situated communication, reference can be established with expressions conveying either precise (Minimally-Specified, MS) or redundant (Over-Specified, OS) information. For example, while in Figure 1, "Find the blue ball" identifies exactly one object in all panels, only in the top displays is the adjective required. There is no consensus, however, concerning whether OS hinders processing (e.g., Engelhardt et al., 2011) or not (e.g., Tourtouri et al., 2015). Additionally, as incoming words incrementally restrict the referential domain, they contribute to the reduction of uncertainty regarding the target (i.e., referential entropy). Depending on the distribution of objects, the same utterance results in different entropy reduction profiles: "blue" reduces entropy by 1.58 bits in the right panels, and by .58 bits in the left ones, while "ball" reduces entropy by 1 and 2 bits, respectively. Thus, the adjective modulates the distribution of entropy reduction, resulting in uniform (UR) or non-uniform (NR) reduction profiles. This study seeks to establish whether referential processing is facilitated: a) by the use of redundant pre-nominal modification (OS), b) by the uniform reduction of entropy (cf. Jaeger, 2010), and c) when these two factors interact. Results from inspection probabilities and the Index of Cognitive Activity — a pupillometric measure of cognitive workload (Demberg & Sayeed, 2016) — indicate that processing was facilitated for both OS and UR, while fixation probabilities show a greater advantage for OS-UR. In conclusion, efficient processing is determined by both informativity of the reference and the rate of entropy reduction.

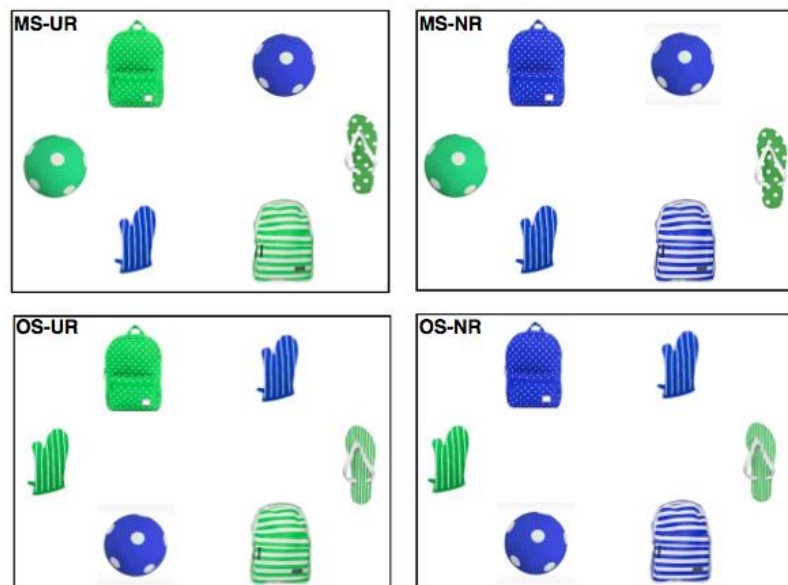**Keywords:** over-specification; entropy reduction; referential entropy; situated communication, eye-tracking

Figure 1. Sample visual stimuli, combined with the utterance "Find the blue ball".

A Materialist Understanding of Spoken Language Development and Functioning

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In a philosophical history involving Plato (arguably), Vico, Goethe, Hegel, Marx and Vygotsky, Ilyenkov (1960) distinguishes *abstract universals* from *concrete universals*. Most cognitive science theorizing about language has been solely in terms of abstract universals – defeasible entities (eg *verb*) created to represent a similarity across many instances (eg '*doing' words*). A concrete universal is a material entity, identified within the relevant domain that is simultaneously an explanation for the phenomena of the domain, within which it mediates every other entity. Abstract and concrete universals can complement each other. Can we identify a concrete universal within psycholinguistic research?

First, 'language' is itself an abstract universal. We need to focus on a material language, such as English (here).

A productive candidate is the *schwa sound* (first sound of 'about'). It is a material sound (as produced by a simple tube), accounting for10% of spoken English, demonstrably mediating every subdomain from phonology to semantics, such that it has a particular foundational role to play in each subdomain and is a material 'fulcrum' between any two. (NB Systems cannot interact without such a material fulcrum.)

We can trace the developmental role of the schwa sound. We can also speculate productively on its role in language evolution. It still plays a role in orienting the listener (Dingemanse et al., 2014) and can be theorized to be the entity that mediates between speaker-listener *common ground* and *new information* for the listener. The schwa sound's role in functor morphology signifies common ground regarding tense, etc.

Keywords: spoken English, universals, schwa sound, language development, language evolution.

Idiom sentence processing elicits larger excitation in M1, compared to metaphor sentence processing

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The embodied cognition view postulates that comprehension of concrete action-related language involves the brain's motor systems. It remains unclear, however, whether they similarly contribute to the processing of figurative and abstract language. Here, we used TMS of primary motor cortex (M1) to investigate the impact of concrete and figurative sentences on motor cortical excitability. Participants read literal ('she caught the lizard'), idiomatic ('he caught the thief red-handed') and metaphoric ('he caught the boss at his office') sentences incorporating hand action-related (e.g. 'to catch') words as well as hand action-unrelated (e.g. 'to come') and abstract sentences ('the company appreciates its employees'). Single-pulse TMS was delivered to left M1, right M1 or control site (vertex). Motor activation was assessed using an area underlying MEPs ($\mu V*ms$) of FDI in each trial. Significant changes in the level of motor excitability caused by literal and figurative sentences with various effectors were observed only in the LH. Processing literal sentences describing hand- performed actions had an inhibitory effect on M1 activation, compared to literal sentences representing non-hand actions. In case of non-literal language, the decrease in motor activation was positively correlated with the increase in figurativeness and complexity of meaning. The significant decrease in motor excitation was observed for processing metaphoric sentences with non-hand effectors, likely, due to the engagement of broader semantic networks necessary for understanding multifaceted metaphoric meaning.

Keywords: embodied semantics, idiom and metaphor processing, TMS-MEP
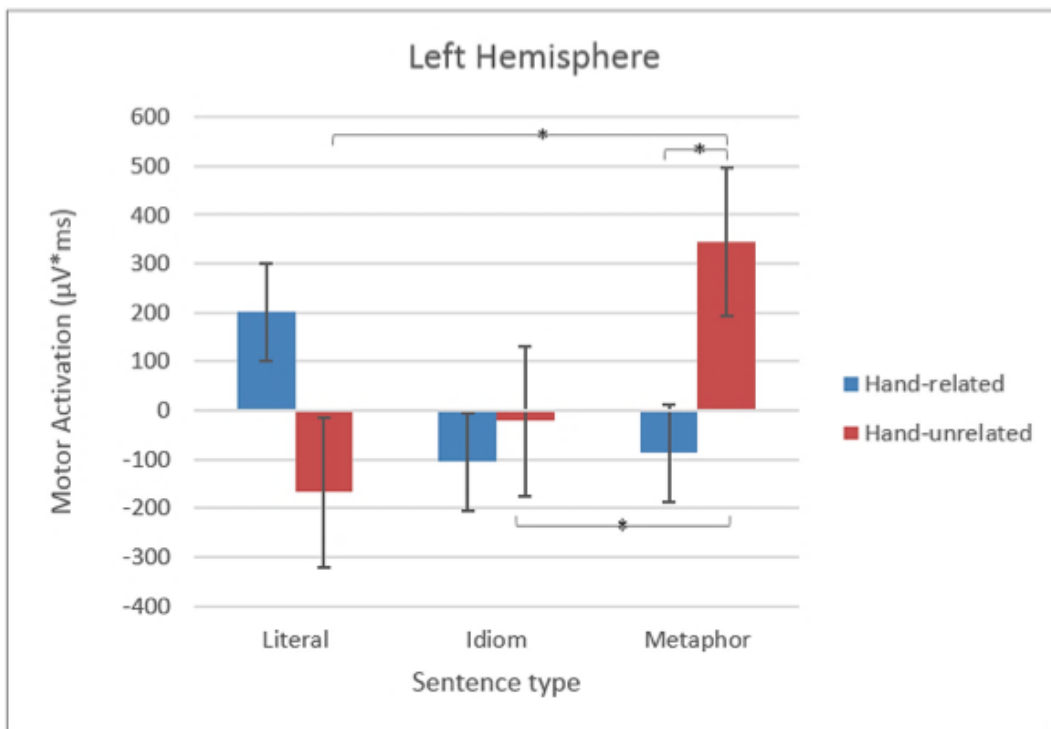
Figure 1. The bars illustrate the mean MEPs area for different sentence types; error bars represent the standard errors. Activation for Abstract sentences is used as a zero baseline. p<,005.

Language Networks on Molecular Level

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My contribution discusses the recent advances in the studies of language networks at a micro level. Although ideas about the uniformity of the traditional Broca-Wernicke network have so far predominantly been tested using fMRI and EEG, new advances in the field of molecular biology have made available new techniques that permit investigating these networks on the level of neurotransmitters. Also, with the development of genetic analysis tools it has become possible to search for the genetic correlates for complex cognitive functions in general, and for language in particular, with the aim of pinpointing crucial genes for the emergence of language in humans. I will focus on data from studies which support the biolinguistic view that human language capacity is a universal ability of human species. The title of this contribution implies the belief that typological diversity of languages and the modality of expression (whether sign or sound) can be disregarded in the context of the neuroscientific study of language. Evidence from neurodevelopmental disorders and neurotransmitter receptor fingerprints will be presented, which suggests the existence of a common molecular basis for the language ability. Novel molecular imaging techniques will be discussed which allow *in vivo* mapping of molecular and cellular phenomena across large brain regions.

Keywords: Universal Grammar, Broca's area, neurotransmitters, genetic correlates, molecular imaging

The Crossword Effect: A retrieval advantage for words encoded in line with their spatial association

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We investigated how words with strong spatial associations are retrieved from memory dependent on how they were spatially arranged during encoding. Pre-testing of an initial set of 129 candidate words yielded 43 words with a strong *horizontal* association (*road*, *runway*, *horizon*, etc.) and 51 words with a strong *vertical* association (*rain*, *rocket*, *shower*, etc.). These were randomly compiled into 66 'crossword arrays' (Fig. 1a), each containing 5 horizontally and 5 vertically arranged items drawn from the pool of *horizontal* words, as well as 5 horizontally and 5 vertically arranged items from the pool of *vertical* words. The main experiment (66 participants) was disguised as "testing how word arrangement affects mathematical problem solving", and had three phases: (1) in the *encoding* phase, participants inspected individually generated crossword arrays (Fig. 1a) for 2 minutes; (2) in the following *distractor* phase, they had to solve simple mathematical equations for 1 minute; (3) in the final *surprize recall* phase, they had to write down as many words as they could remember from the encoding phase. Dependent variables were (i) percentage of recalled words and (ii) average ranks of recalled words in the recall list. Results showed no appreciable effects in recall percentage (~48% overall, Fig. 1b), but a clear interaction between *word association* and *word presentation* in retrieval rank (Fig. 1c): Words appeared reliably earlier in the recall list if they had been presented in line with their spatial association during encoding. We interpret this result as being consistent with the perceptual symbol hypothesis.

Keywords: free word recall, spatial association, crossword effect, encoding, retrieval
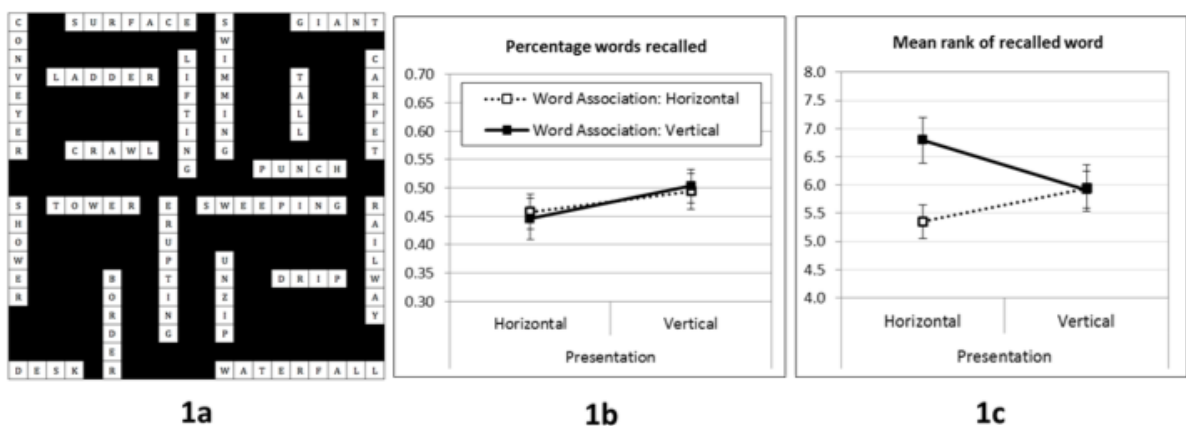
Figure 1: (a) Example crossword array; (b) Percentage of recalled words; (c) Mean retrieval rank of recalled word

Exploring the conceptual basis of multilingual language processing: A priming study with German learners of English

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The last two decades have seen a lot of research concerned with multilingual language processing and cross-linguistic transfer (see e.g. Altarriba & Basnight-Brown 2009), suggesting dynamic and bi-directional interaction between L1 and L2 (e.g. Malt et al. 2015). An unsolved theoretical question in this context is the specific nature of interrelations between linguistic and conceptual level for L1 and L2, including the question whether language-specific conceptual systems are proposed (see e.g. Jared et al. 2013).

These questions are not only relevant to theories of multilingualism, but can and should inform general models of language processing and the linguistic-conceptual interface. In contrast to dual coding approaches (e.g. Santos et al. 2011, Jared et al. 2013), I propose a fully grounded account of multilingual language processing based on a corresponding model of translation processing (Sickinger in preparation). From this perspective, meaningful language use presupposes the activation of a language-independent conceptual layer commonly accessed by L1 and L2.

In order to empirically test my claims, I am currently conducting a priming study in which German learners of English are alternately subjected to picture assessment tasks and a variant of the perceptual identification task (see e.g. Pecher et al. 2002). Words presented and instructions to the picture task vary between L1 and L2, making it possible to measure interlangual co-activation via the respective success-rates in word naming. I will argue that any observed priming can best be explained by activation of shared conceptual representations, especially as some of the prime-target relations are of purely associative nature (e.g. CAKE-*sweet* and CAKE-*süß*).

Prosodic temporal patterns as an embodiment of syntax

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Neurolinguistic theories are challenged by the amodal abstract representations assumed by linguists. Theories of embodied linguistics ground abstract representations by offering a conceptualization of the relationship between linguistic representation, experience, and the brain. Findings correlating brain activation patterns with referential features of words (e.g., body parts), suggest that the mechanism underlying linguistic embodiment is an ''action–perception simulation''. This mechanism accounts for embodied representation of words, but is harder to adapt to syntactic abstractions. In this theoretical paper we suggest that temporal patterns of brain activation that resonate to temporal patterns of the speech signal may constitute the missing link. Speech prosody is the temporal organization of the acoustic signal of speech. It is highly correlated with the syntactic structure of the language, and it is a sensory-motor phenomenon that can evoke an ''action–perception simulation'' that underpins the syntax- experience-brain association. We offer an innovative integration of psycholinguistic and neurocognitive studies into a new approach to linguistic embodiment. Building on this integration we propose a novel implementation of the syntax-experience-brain relationship via the mapping between the temporo-spectral aspects of speech prosody and temporo-spectral patterns of synchronized behavior of neural populations. We discuss the potential implications for psycho- and neuro-linguistic research.

Embodiment of Literature: EGG while listening to book excerpts distinguishes between fiction and documentation

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In 2013, an influential study by Kidd & Castano demonstrated that in contrast to reading "popular" fiction (PF), reading fiction of award‑‑‑winning and canonical authors (i.e. "Literary" fiction (LF)) instantly improves a reader's aptitude to understand the mental state of others. According to the authors, LF does so because it leaves a lot to the readers' imagination and forces them to fill in gaps and search "for meanings among a spectrum of possible meanings". This trains the psychological processes needed to gain access to the characters' subjective experiences. We believe that the explanation provided by the authors is incomplete. Rather than driven by the filling‑‑‑in of gaps left by the imprecise verbal description, our hypothesis is that beyond content, specific linguistic markers and stylistic elements, which involve the precise description of scenes, action, and emotions, drives a "simulation of reality". These language‑‑‑induced mental simulations allow a genuine experience of the depicted situation and could, by this virtue, drive cognitive and affective enhancement. To support our assumption we present:

i) Objective markers that distinguishes between different types of literature (LF, PF, and documentations) and show that the use of e.g. verbs, adjectives and adverbs differs between the three classes of literature.

ii) A novel way to analyze EEG data obtained during listening to LF and Documentaries. By averaging EEGs over large time windows (>10s) we identify patterns that remains rather constant across time and that distinguishes between LF and Documentaries at the level of single participants (see Fig. 1).

The approach that we present provides new tools to approach issues related to embodied language processing.
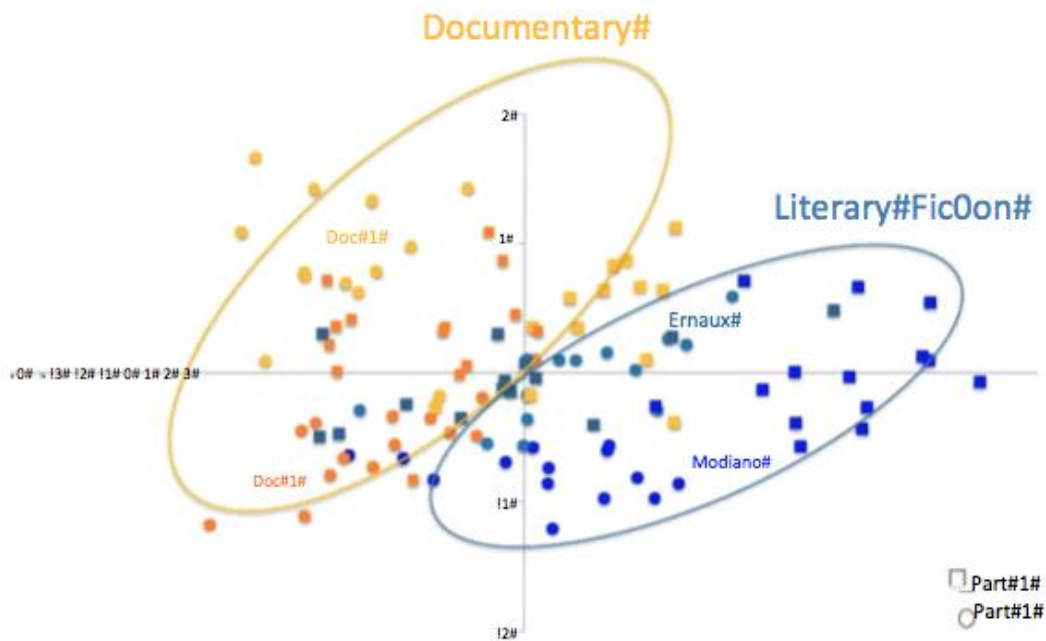
Figure 1: Principal component analysis (data from one individual participant). Each dot represents EEG amplitude (averaged over 10s) in subsequent time windows while listening to book excerpts. The symbols are colored according to the type of literature (bluish = Literary fiction; Yellowish = Documentary). Participants listened to four excerpts (2 x LF by P. Modiano and by A. Ernaux and 2 x Documentaries about slavery and about the re---introduction of wolfs in France) each containing two parts (separated by a break). The squares give data for the first part of each excerpt and the circles for the second. Data clearly distinguishes between documentaries and fiction, which could suggest that our method captures brain activity related to the way content is apprehended.

Size Matters: Effects of Relative Distance on the Acceptability of Spatial Prepositions

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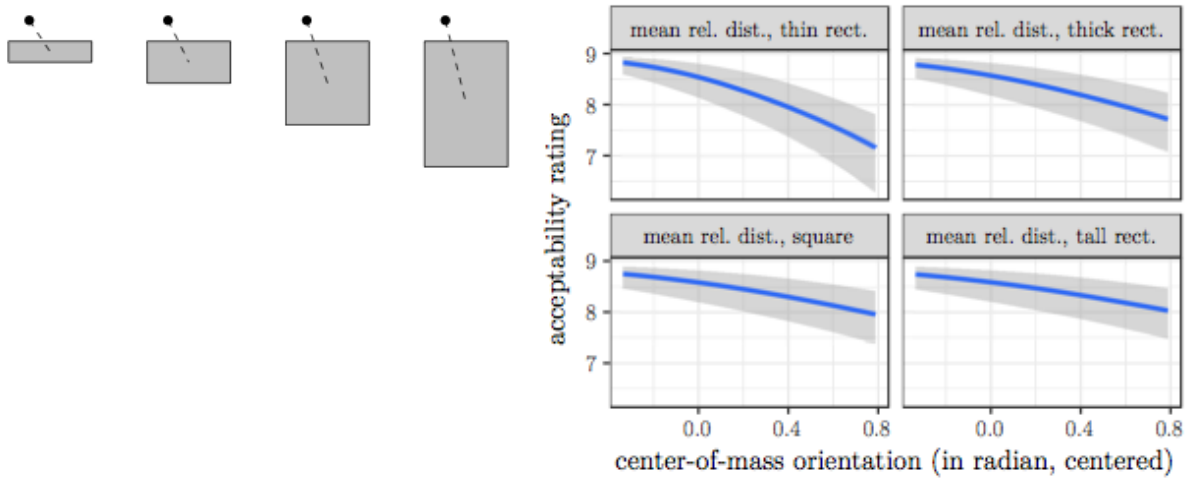
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For sentences such as "The circle is above the rectangle", the geometric properties of the mentioned objects modulate participants' sentence acceptability ratings (given object depictions; [2]). Among the geometric properties is the center-of-mass orientation, i.e., the orientation of an imaginary line between the centers-of-mass of two objects (dashed lines in Fig. 1a). [2] found that the more this orientation deviates from canonical upright, the lower people rate the acceptability of the spatial preposition *above*.

A computational cognitive model of this task (the rAVS model, [1]) assumes that the influence of the center-of-mass orientation reduces with lower relative distance. Relative distance is defined as the distance from the circle to the rectangle divided by the dimensions of the rectangles (with equal absolute circle placements: the taller the rectangle, the smaller the relative distance).

To test this assumption, we placed 18 circles above 4 rectangles with different heights (Fig. 1a) and asked people to rate the acceptability of the German sentence "Der Punkt ist über dem Objekt" ("The dot is above the object"). The taller the rectangles, (i) the *relatively* closer are the circles to the rectangles, and (ii) the less deviates the center-of-mass orientation from canonical upright.

Ratings did not differ across the (taller vs. shorter) rectangles but lower relative distance (cf. subplots of Fig. 1b) correlated with lower influence of the center-of-mass orientation on acceptability ratings (decreasing steepness of slopes). This confirms rAVS's predictions and suggests that geometric properties of objects matter for relating spatial language to object depictions.

Keywords: spatial language, cognitive modeling, language and perception, visual attention

(a) Example stimuli used in our rating study. Dashed lines depict center-of-mass orientations.

(b) Effect of center-of-mass orientation on ratings conditioned on mean relative distances for the four rectangles (Bayesian regression model fits with 95% credibility intervals).

Figure 1: Stimuli (a) and results (b) of our study.

Language Acquisition, Simulation and Phenomenology

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Our talk zeros in on the development of our novel approach to cognitive activity from a phenomenological perspective, resented in [2] and [3]. Very briefly, this approach can be characterized via the following guiding principles.

1. Intentionality is considered as a universal fundamental characteristic of cognition shared by animated bodies of various kinds.

2. Thus understood, intentionality is presented as functional relation from stimuli (taken as intended objects) to recognized (meaningful) individuals, relativized to a particular subject. It makes implicit the meaning-bestowal function of intentionality: it transforms a stimulus into an ideal meaningful (intentional) object.

In particular, as consequence of this approach a categorization process was modeled via analogous apperception-like function.

In what follows we will develop these ideas applied to language acquisition and comprehension. Taking as starting point a phenomenological interpretation of simulation theory of meaning, we address the problem of processing abstract words meanings. Recent research (eg. [1]) in the field offer a rich experimental data in support the idea that affective states play an important, if not crucial, role in the representation of abstract concepts. Taking the next step in this direction we argue in favor of consideration a set of emotional states as a kind of pre-linguistic material paving the way for further language faculty.

Keywords: intentionality, simulation, emotion, language acquisition, phenomenology.

Large ants and small mansions: To what extent do perceptual manipulations affect word processing?

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There is considerable evidence that representations of word meaning are "embodied" and grounded in our perceptual and motor experiences (Barsalou, 2016; Glenberg, 2011; Pulvermuller, 2013; Zwaan, 2009). This research has mostly relied on priming and interference procedures, or measuring brain activity. Little work seems to have been done to investigate embodiment by examining the extent to which perceptual experiences may be incorporated into existing representations to potentially alter their processing, and whether those effects persist over time. I will present a series of experiments where we manipulated the perceptual appearance of words, specifically font size, to be congruent or incongruent with an object's actual size (e.g., elephant presented in a large or small font, respectively). In Experiment 1 repeated instances of the stimuli were presented before recognition memory and property judgment tasks in the same session and after a 2-week delay. Subsequent experiments presented the same stimuli in tasks involving more immediate "online" responses like most prior research. Experiment 2 required participants to perform lexical (word/nonword) or semantic (natural/artificial) decisions, while participants in Experiment 3 made size judgments on either the visual appearance of the word, or the item it represents. Across experiments, the perceptual font size manipulations generally did not significantly affect participants' responses, although certain issues and explanations will be discussed. We have just started conducting similar studies involving manipulations of color. Depending on the status of this work and if time permits, I will also present results from our first experiment with color.

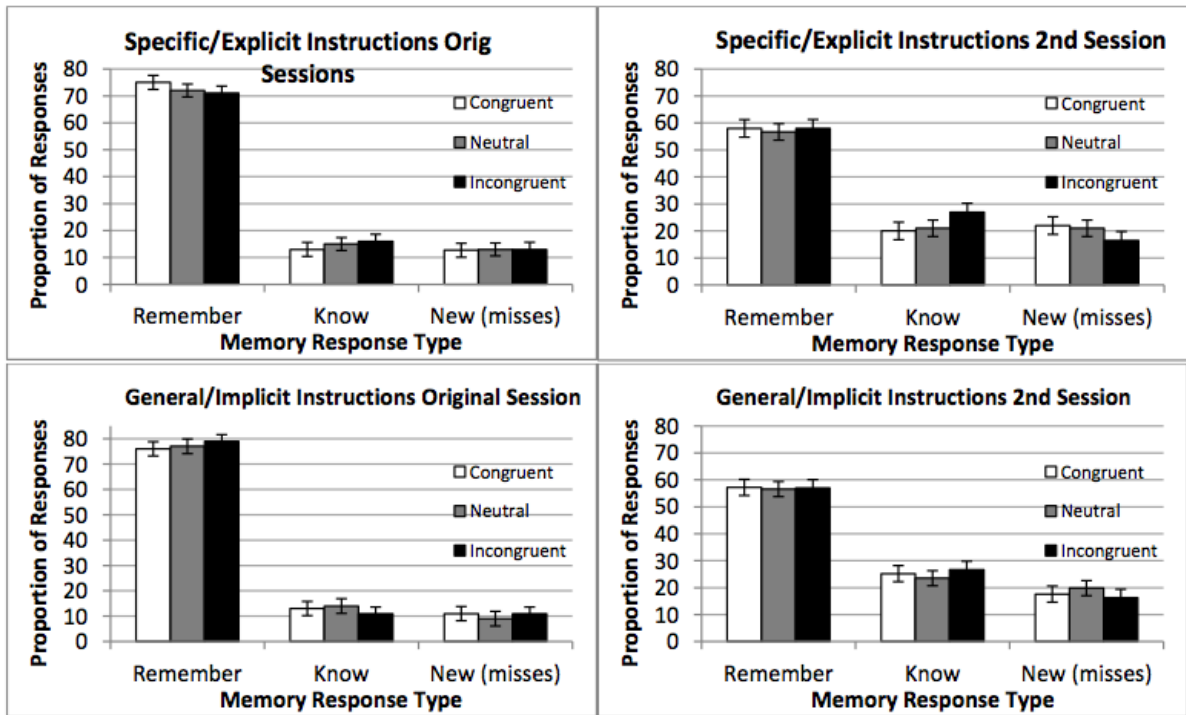**Keywords:** perception, size, semantics, memory, word recognition

Figure 1 from Experiment 1, showing recognition memory data in terms of the proportion of correct responses for each response type across font congruency conditions for the original and second session specific and general instruction conditions. The figure for property judgment results is similar. Preliminary data from this study was presented in a poster at the 2013 ESLP meeting in Potsdam. Experiments 2 and 3 with LD, SD, and 2 types of size judgments, along with the color study, are new and haven't been presented at the conference yet.

Secondary nomination in Mongolian and Russian language picture of the world (based on zoonyms)

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The project aims to describe the semantics of everyday words formed in everyday communicative experience of the Mongolian and Russian native speakers. The main objective of the study is to identify language universals and cultural specifics of the ordinary language meanings of the words in the two compared languages.

The main method of research is a psycholinguistic associative experiment. The stimuli were 10 Russian and 10 Mongolian words that form the thematic group "Pets". Total collected 12,000 associations.

Reflection and understanding of the world is inextricably linked to nominative human activity. Our study proves the efficiency of using the names of Pets for the secondary signification by native Mongolian and Russian languages of natural objects, artifacts, and entities. Analysis of the principles of the nomination of artefacts by Mongolian and Russian native speakers proves that the nature of the nomination in different ethnic areas are the same.

This is evidenced by the almost complete coincidence of the principles of the category of words obtained by surveying Mongolian and Russian native speackers. The major differences concern the productivity of the principles of the nomination, which for some is very significant, and for others not so important. The coincidence of the principles of the nomination in different regions can be explained by the same inclusion of Pets into everyday practice of people. Significant differences in the productivity of the principles of the nomination in the sphere of extralinguistic reality, depending on the extralinguistic terms of naming and cultural factors.

The cultural factors also play an important role in the transfer of title of the animal to the person.

Keywords: national language picture of the world, nominative-associative field, pets, Mongolian language, Russian language.

«Modality in modality». Audiovisual perception of words with audiovisual semantics[1]

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According to the theory of perceptual symbols L. Barsalou, human perception of word semantics correlates with human perceptual channels. For example, people perceive the phenomenon of color by a visual channel. Therefore words with semantics of color (e.g. red, yellow, green, etc.) are more successfully perceived through the visual channel. Words with semantics of sound (e.g. loud, sonorous, etc.) are more successfully perceived through the auditory channel.

Feature words as the object of research lies in its ability to exist in two forms: visual (as a letters) and auditory (as a sound). In several behavioral experiments (exp. 1 and exp. 2), we investigated the perception of words with auditory and visual semantics separately for the visual and auditory perceptual channels.

But human perception is multimodal, that is, exists simultaneously in several perceptual channels. If to visual perception of words with the visual semantics to add auditory perception with auditory semantics – what will change?

Our interest is the situation in which a respondent on two channels (auditory and visual) perceives words with auditory and visual semantics at the same time.

In experiment 3, pairs of words were presented: one word in headphones, the other on the screen. All words had audial or visual semantics. The analysis showed that if the semantics of the word match in the visual perception channel (e.g., the word red appears on the screen), the influence of semantics of the auditory channel is insignificant.

However, in a situation when on the screen appears the word with mismatch semantics (e.g., ringing on the screen), the semantics of auditory stimulus is important in two cases:

First, the appearance of a word with an auditory semantics (e.g., sonorous) in the auditory modality (the distracter for visual modality) shortens the processing time of the visual stimulus.

Secondly, the appearance of a word with an visual semantics (e.g., red) in the auditory modality increases the processing time of the visual stimulus.

Keywords: perceptual symbols, multimodality, perception, text processing, RT

Abstract, Emotional and Concrete Concepts and the activation of mouth-hand effectors

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One of the main challenges for embodied and grounded theories is to account for terms the referent of which is not a single physical entity, or that are only slightly related to sensorimotor experience, namely abstract concepts like "freedom" or "phantasy". Recent views propose that abstract concepts are not only grounded on perception and action but they rely more than concrete concepts on linguistic and social experience. If this is the case, according the Words As social Tools (WAT) proposal, they should activate the mouth more than concrete concepts. We performed this study in order to test this prediction.

Selected abstract, emotional and concrete words on a computer screen were proposed to participants. They had to perform two different tasks, in sequence: a lexical decision and a recognition task. Participants responded directly with the hand or the mouth using a specific button.

Results show that the mouth condition interferes with both tasks, producing slower RTs, probably due to the peculiarity of the device. A concreteness effect, i.e. a disadvantage of abstract concepts compared to the other ones, was found in the recognition task. However, the effect was driven by the hand; with both concrete and emotive concepts we found an advantage of hand over mouth response, while with abstract concepts hand and mouth responses did not differ.

The mouth effector strongly interferes with both concrete and emotional terms, while not with abstract concepts, thus supporting the idea of a re-enactment of linguistic information in the processing of abstract terms.

Keywords: embodied cognition, grounded cognition, concepts grounding, abstract concepts, language processing.

Verbal rumination as simulated speech

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Rumination can be defined as a recurrent mode of response to negative affects [1] or life situations [2]. Rumination is predominantly verbal and can be considered as a particular case of inner speech (IS). The Motor Simulation hypothesis (MSH) suggests that IS may be a *kind of motor action* [3]. It received support from physiological and neuroimaging studies [4]. Under this hypothesis, verbal rumination (VR), as an instance of IS, should involve speech-related muscle activity, in addition to emotion-related facial activity.

Two studies were conducted aiming to test the MSH in the context of VR. First, we recorded electromyographic (EMG) activity in three facial muscles (speech-related: lips, emotion-related: forehead) and one forearm muscle (control), during 2 conditions: induced VR and Rest. Results showed an increase in speech- and emotion-related EMG signals in the VR condition vs Rest. The facial EMG increase was associated with subjective reports of rumination and could not be explained by increased general muscular tension, as forearm EMG remained constant.

A second study further investigated the involvement of lip muscles in VR by asking participants to either engage in a labial activity (articulatory suppression) or tap with their finger (control) while ruminating (after induction). A post-experiment questionnaire assessed rumination modality (verbal or not). We observed a stronger decrease in self-reported rumination after the labial activity than after the control condition, especially when rumination was verbal.

Altogether, these results support the hypothesis that VR is a kind of simulated speech and suggest new means to objectively assess rumination.

Keywords: inner speech, rumination, electromyography, articulatory suppression, motor simulation

An empirical study of multichannel communication[2]

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When we communicate, we not only use verbal devices, but also non-segmental prosody, gestures performed by hands and other limbs, postures, facial expressions, eye gaze, etc. All these devices form communication channels, belonging to the auditory and visual modalities. Figure 1 summarizes the notion of multichannel discourse.
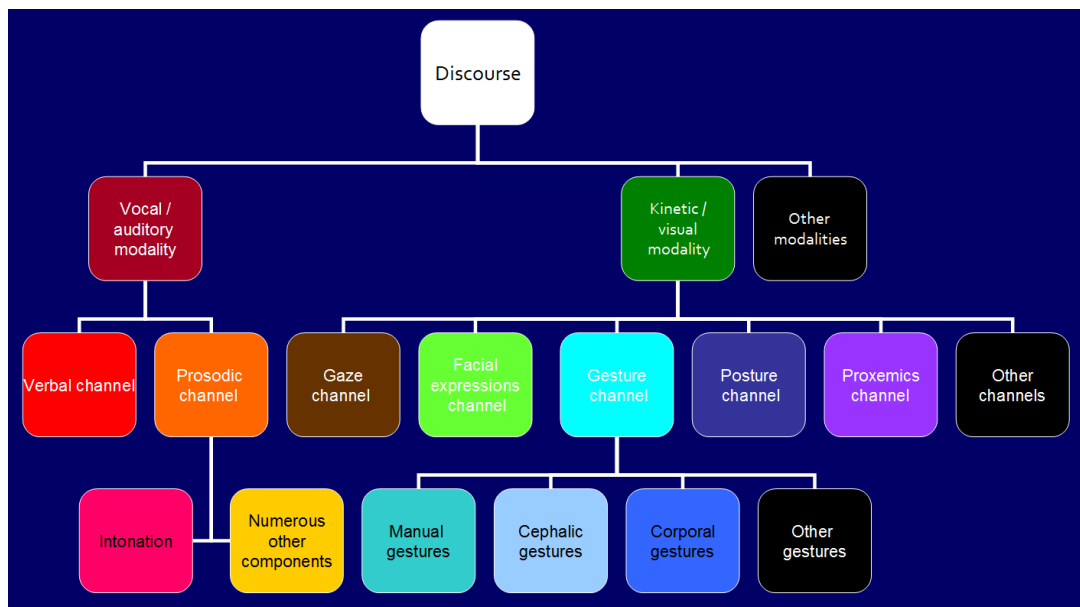

Figure 1.

Human beings are involved in multichannel communication throughout their lives. However, this phenomenon is still poorly understood and even documented, because it is an ephemeral process and because relevant studies are traditionally divided between different disciplines. In this project we attempt, first, to register the multiple channels of communication via the use of advanced technological solutions and, second, to overcome the traditional disciplinary boundaries, looking at most of the channels shown in Figure 1 within one framework.

Our research group is creating a resource named "Russian pear chats and stories", see www.multidiscourse.ru (the web site is in Russian). This resource consists of 24 communication episodes, or "recordings", lasting from 12 to 38 minutes each and consisting of monologue and interactive parts. Each recording is represented with a set of 10 synchronized media files that objectively register the participants' vocal, kinetic, and gaze behavior. For each recording various annotations are provided, including transcripts of

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speech (the verbal component and many aspects of prosody), annotations of manual and cephalic gestures, and annotations of oculomotor behavior. This corpus is growing into one of the first resources allowing one to analyse human communication in its actual richness.

There is a wide variety of research issues that are being explored with the help of this resource, ranging from most theoretical ones, e.g. a multichannel reinterpretation of communication roles, turn-taking, or pausing, to more technical ones, such as precise temporal coordination between prosodic and gestural units.

Keywords: communication, multimodality, corpus, gesture, discourse.

Visuo-semantic size congruency effects in concrete and abstract word recognition

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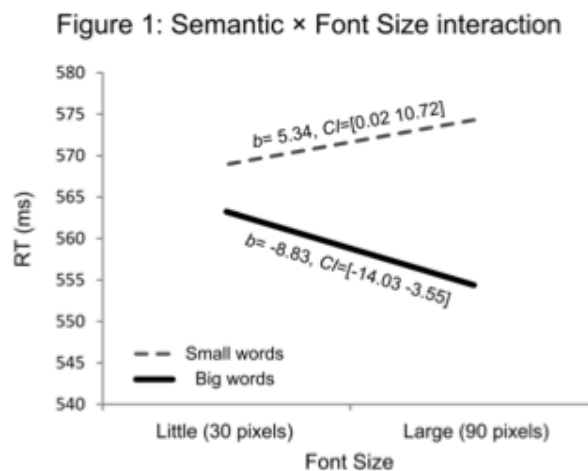
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Previous research has demonstrated a processing advantage for semantically ''big'' versus ''small'' words having either concrete (e.g., *jungle* vs. *needle*) or abstract (e.g., *trust* vs. *trace*) meanings [1,2]. This bigger-is-faster effect has been attributed to differential lexical processing of "size" based on visuo-spatial sensory features associated with concrete words and on emotional qualities associated with abstract words [2].

The current research investigated the visuo-spatial grounding of size in concrete and abstract words by examining the interaction of visual font size and word semantic size in a lexical decision task (notably, without explicit judgments of font or semantic size). Fifty participants were tested on 220 target words in a 2 (Concreteness: Concrete, Abstract) × 2 (Semantic Size: Big, Small) × 2 (Font Size: Large, Little) within-participants design.

Using maximal linear mixed models, we found that concrete words were processed faster than abstract words [b=-16.48, t=-4.64, p<.001], and that semantically big words were recognized faster than semantically small words [b=-12.83, t=4.05, p<.001]. There was also a Semantic Size × Font Size interaction [b= -14.18, t=-4.04, p<.001], indicating a visuo-semantic size congruency effect (**Figure 1**). No other effects were significant.

Figure 1: Semantic × Font Size interaction

The findings demonstrated facilitated processing when the semantic size and visual font size were congruent, for both concrete and abstract words. The latter is surprising because, unlike concrete objects, abstract concepts are not directly linked to our sensory-motor experiences of the physical world. The size congruency effect in abstract words may be metaphorical in nature [3], or mediated by font size-emotion generalizations [4].

Keywords: sematic size, concrete, abstract, word recognition, lexical decision

Dissociation between action and motion verbs: Evidence from stroke

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Left hemisphere stroke patients ($N = 6$) and healthy age-matched controls ($N = 15$) completed tasks on action (e.g., holding, clenching) and motion verbs (e.g., crumbling, flowing). The tasks required participants to correctly identify a matching verb (semantic task), point to an associated picture (verb-picture matching), and lexical decision. Dissociations on action and motion verb content depended on lesion site. First, patients with lesions involving posterior parietal and lateral occipitotemporal cortex showed selective deficits in processing motion verbs. In contrast, patients with more anterior lesions sparing posterior parietal and lateral occipitotemporal cortex showed deficits in verbs describing motionless actions. Interestingly, the semantic task alone revealed this dissociation; neither the lexical task nor traditional measures of aphasia revealed impaired performance. These findings support the hypotheses that semantic representations for action and motion are behaviorally and neuro-anatomically dissociable. The findings clarify the differential and critical role of perceptual and motor regions in processing modality-specific semantic knowledge as opposed to a supportive but not necessary role. We contextualize these results within theories from both cognitive psychology and cognitive neuroscience that make claims over the role of sensory and motor information in semantic representation.

Keywords: neuropsychology, lateral occipitotemporal cortex, embodied cognition, semantic representation, aphasia

Patient percentage correct for the semantic tasks on the SSJT at initial testing, the VPM, and the Lexical Decision task.

Patient *(lesion)*	SSJT				Verb-picture matching				Lexical			
	+A+M	+A-M	-A+M	-A-M	+A+M	+A-M	-A+M	-A-M	+A+M	+A-M	-A+M	-A+M
CC[a]	92	100	92	100	100	100	100	100	100	92	100	100
TY[b]	100[1]	67	100	67	100	100	100	80	100	100	100	100
MAS[b]	89	67	100	100	100	100	100	80	89	100	100	100
SB[b]	78	83	100	100	78	83	100	60	89	100	100	83
DH[d]	33	67	17	83	100	83	83	80	100	100	100	83
FR[c]	89	100	83	67	100	100	100	80	100	100	100	100
JC[c]	78	100	50	83	100	75	100	50	89	100	100	100
Controls (SD)	88(5)	99(4)	97(7)	97(7)	100(0)	100(0)	100(0)	88(12)	n.t.	n.t.	n.t.	n.t.

Dark shaded areas in the table highlight the expected pattern of impairments, and light shaded areas highlight the expected dissociating intact performance.

[*] $p < 0.05$;
[**] $p < 0.001$;
[1] Patient performance better than control group.
[a] Unclassified lesion (patient scan too early to identify lesion).
[b] More anterior lesions sparing posterior parietal and lateral occipitotemporal cortex.
[c] Lesions involving posterior parietal and/or lateral occipitotemporal cortex.
[d] Widespread left hemisphere lesion including both posterior and more anterior regions of interest.

Conceptual processing of up/down words (cloud/grass) recruits cortical oculomotor areas

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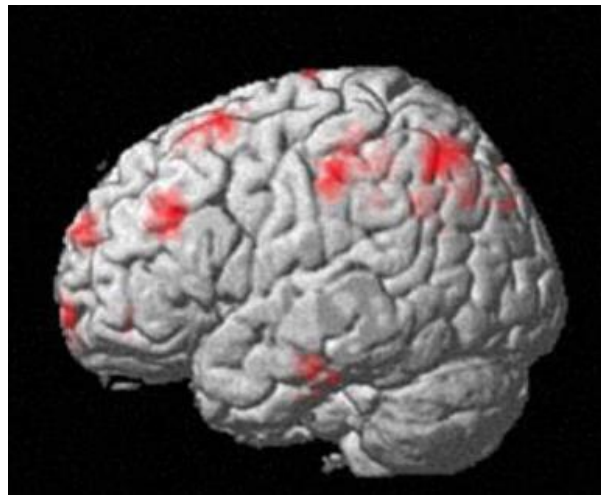
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Behavioural evidence suggests that processing words with spatial up/down associations (e.g., cloud vs. grass) influences performance at detecting/discriminating visual targets appearing in compatible vs. incompatible location (Gozli et al., 2013). Recent eye-tracking studies (Dudschig et al., 2013; Dunn, 2016) indicate that such implicit up/down words modulate vertical saccade latencies. Based on these findings, we tested the hypothesis that conceptual processing of up/down words recruits the cortical network for saccadic eye movements. We collected functional magnetic resonance imaging data from 18 participants who performed a semantic judgement task on 12 up words, 12 down words, and 24 abstract control words. Searchlight-based multivariate pattern analysis was used to identify brain areas from which the words' spatial associations could be decoded. Our main result was above-chance classification in a set of key areas that together constitute the saccadic eye movement network: a left-lateralized cluster close to the junction of the precentral sulcus and superior frontal sulcus (frontal eye field), a right-lateralized cluster in the supplementary motor area (supplementary eye field), and a bilateral cluster in the superior and inferior parietal lobules extending into the precuneus and occipital cortex in the left hemisphere. This suggests that conceptual processing of up/down words at least partly involves cortical oculomotor areas central for planning and executing saccadic eye movements.

Keywords: conceptual representation; implicit up/down words; multivariate pattern analysis; looking network

Primary Motor Cortex is Involved in Online Word Learning: A Continuous Theta Burst TMS Study

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Language processing recruits a fronto-temporal cortical network, which is complemented by a distributed network of modal areas, such as the motor cortex, that encode modality-specific referential aspects of meaning. Since most studies typically focus on already fully-formed adult vocabulary, it remains unclear how and when exactly modality-specific areas become involved in language processing. Here, we addressed this using a 3D virtual reality-based learning game to teach adult participants new action verbs and object nouns, such that their meaning was learned in a contextually relevant and immersive fashion. We used offline continuous theta-burst stimulation over primary motor cortex (M1, defined using individual MRI images and fMRI localiser task) to test the hypothesis that this area selectively encodes aspects of action verb meaning early on in the process of word acquisition. Our results indicate that TMS of M1 (as opposed to a control site in a different participant group) interferes with the learning process, as revealed by a significantly increased number of errors during training. This variable encoding accuracy between the motor and control TMS groups was further corroborated in a post-learning lexical decision task, which showed that significant between-group RT differences were only pronounced for newly learned action verbs, but not for new nouns. Overall, our study highlights rapid brain plasticity during word learning, and the motor cortex's functional involvement in its earliest phases.

Keywords: TMS, language, learning, action

Discourse Acquisition by Russian Preschool-aged Children: the Case of Pear Film Retelling

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The general idea underpinning the authors' work is the conjecture that, for babies, toddlers and preschool-aged children, it is more appropriate to explore the acquisition of discourse as a whole (i.e., multimodal communication, which includes gestures, facial expressions, prosody, pauses and discursive markers), rather than the acquisition of language. The procedure of the research has been based on a "pear film" experimental line. "The Pear Film" is a six-minute movie made by Wallace Chafe in 1975 in order to explore how people of different languages and cultures conceptualize the same material. This movie has yielded a rich research tradition of so-called "pear stories" (Chafe 1980; Orero 2008; Matzur, Mickievicz 2012; Vilaró 2012; Chelliah 2013). Over recent years, "The Pear Film" has been also exploited for the purpose of analysing multimodal communication (Kibrik et al. 2015).

The experimental database of this research comprises 76 "pear stories" recorded in Moscow schools and kindergartens (50 of which were retold by children aged five to seven years, while the remaining 26 were retold by 15 to 17-year-old adolescents). The authors focused on three characteristics of the discourse: a logical structure and a coherence of the narrative; discourse words and pauses; and gestures and spontaneous movements without a communicative meaning. A few notable differences between the two target age groups were discovered. Also the correlation between narrative skills and communicative skills of preschool-aged children was explored. The results provide clear evidence to support the claim that various parts of the discourse are consistently acquired.

Keywords: Multimodal communication, discourse, language acquisition, narrative, pear film

POSTER PRESENTATIONS

Sensorimotor stereotypes in language: evidence from language development[3]

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The modern cognitive linguistics posits the importance of context in the functioning of language, and in its development in phylogeny and ontogeny. Typical strategies of orientation and actions in situations predetermine the formation of prototypical language structures (Bruner, 1975). It was shown that ontogenetic sensorimotor stereotypes that reflect normal sequences of object manipulation are used by aphasia patients to compensate their disorders of instrumental and prepositional constructions comprehension (Bergelson et al., 2011, Dragoi et al., 2015). Similarly, one can interpret the understanding of active and passive structures by patients with Broca's aphasia, following the rule "The first Noun is an Agent" (Akhutina, 1989).

In our study we check whether a strategy based on the word order is used in understanding reversible sentences by primary schoolchildren. Methods: (1) Computer-based test of understanding logical-grammatical constructions; (2) neuropsychological assessment adapted for children 5-9 years.

33 first-graders (fgs) and 64 second-graders (sgs) participated in the study. The results show that 9% of fgs and 37.5% of sgs understood passive constructions without mistakes, 52% of fgs and 25% of sgs used word order strategy, and 39% of fgs and 37.5% of sgs took into account grammatical features of constructions.

Neuropsychological evaluation showed that the best state of higher mental functions was in the first group, and the worst was in the group with the strategy based on the word order. Children, who took into account grammatical features, differed from them by the best development of the functions of the left hemisphere, more adapted for operating language.

Keywords: Sentences comprehension, Logical-grammatical constructions, Computer-based tests, Neuropsychology, Neurolinguistics

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Individual difference in gesture sensitivity: the role of empathy

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Existing studies on gesture comprehension point towards individual differences in 'gestural sensitivity' that are associated with age (i.e., adults tend to obtain information from gesture while younger children tend to ignore it). In addition, findings reveal that ASD individuals perform poorly on tasks of gesture comprehension. Given that ASD individuals also demonstrate poor performance on tasks requiring empathy, in this study, we hypothesised that empathy might be an important construct governing 'gestural sensitivity'. We used a task of multimodal integration. Participants (n = 95) were presented with either a spoken sentence (e.g., a still image of an actor uttering the phrase 'I throw') or an iconic gesture (e.g., a video clip of an actor producing a throwing gesture with two hands while sound was muted) or an audio-visual combination of the two. Their task was to select a photograph that best corresponded to the meaning conveyed. Participants also completed an empathy questionnaire. Performance was better in the two unimodal conditions than the audio-visual combination. However, overall performance was at ceiling. Critically, participants who were more sensitive to gestural than verbal information in the audio-visual condition (measured through an error analysis) also showed higher empathy levels. These findings suggest that people's ability to infer the mental state of others is related to their ability to obtain information from gesture, and not necessarily from speech.

Keywords: gesture comprehension, iconic gestures, empathy, individual differences, multimodal communication

Table 1. Correlation coefficients (* $p < .05$, ** $p < .001$)

Variables	1.	2.	3.
1. Gestural sensitivity	-	.470**	.234*
2. Verbal sensitivity	.470**	-	-.076
3. Empathy	.234*	-.076	-

The role of mental images in metaphor comprehension[4]

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The role of mental images in metaphor comprehension is one of the controversial issues of metaphor theory. To find out what are the mental representations of the components of metaphor (topic and vehicle), we compared the comprehension of verbal metaphors and their "literal" pictorial analogs ("dive into a book", "reading is a road", "reading is a flight"). Subjects of one group received three verbal metaphors, subjects of another group - three pictorial metaphors (23 people in each group, students, 18-21 years old). The task was to answer the question: "What is the meaning of this picture / this metaphor?"

When working with the pictorial metaphor to "Jump into the book", the subjects actualized the associative field related to diving and swimming: the importance of training for the reader-diver (30.4 % for pictorial metaphor vs 0% for verbal metaphor), the danger for not gaining the end of the book (13% vs 0%). For the pictorial metaphor "Reading is a road", the tortuosity of the road was mentioned as the difficulty of reading (21.7% vs 0%). With the pictorial metaphor "Reading is flight", it was noted that reading helps to see something new (43.1% vs 0%), rise above the world of fuss (39% vs 0%), get new opportunities (56.5 % vs 0%), for verbal - flight of fantasy (52.1% vs 21.7%).

Conclusion: when working with verbal metaphors, subjects do not actualize the detailed and fully extended images, associated with vehicle (the process of jumping, swimming, flying or traveling). Their understanding is guided by own experience of reading and linguistic connotations, associated with the topic of metaphor.

Keywords: mental image, pictorial metaphor, verbal metaphor, comprehension.

Pictorial metaphors "Jump into a book", "Reading is a road", "Reading is a flight"

The role of embodied cognition in space metaphor processing

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The aim of this research is to answer the question: how sensorimotor processes affect space metaphor processing.

There is a hypothesis that sensorimotor processes are automatically activated from the early stages of word recognition and constitute an intrinsic part of semantic processing. There is a growing evidence of mutual influence between language and sensorimotor experience (Boroditsky, 2000; Boroditsky & Ramscar, 2002; Wilson et. all, 2006; Glenberg & Kaschak, 2002; Casasanto & Lozano, 2007).

Nevertheless, several studies (Bottini & Bucur, 2016) do not support this suggestion. They report that the sensorimotor system plays an active role in language understanding, although it may not be necessary.

Our research is dedicated to the "up-down" metaphorical scale. It was shown that bottom is associated with weakness, while top is with power (Shubert, 2005). According to Lacoff & Johnson (1980), "upward" means "more" and "downward" means "less". However, this scale meaning is not so univocal and an opposite case may occur (e.g. in Russian language): "downward" means "more", because occasionally it might be related not to height but to depth (Lee Su Hyoun, 2005; Lee Su Hyoun & Rakhilina, 2005).

We selected metaphors with extreme rates of four space scales (up, down, superficiality, depth) via both expert evaluation method and subjective scaling. Preliminary correlations between these scales for five "highest" and five "lowest" metaphors are presented in Table 1. As it can be seen "superficiality" does not obviously mean "up".

Further work with stimuli selected is aimed at finding an embodied component at their processing.

Table 1. Spearman's correlation coefficients between metaphorical scales.

	Down	**Depth**	**Up**
Down			
Depth	.758 (p = .011)		
Up	-.805 (p = .005)	-.804 (p = .005)	
Superficiality	-.332 (p = .349)	-.336 (p = .342)	.399 (p = .254)

Keywords: metaphor, language, processing, embodiment, space.

Predicting effects of motor training from modulation of TMS-evoked response during movement observation

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Since the relatively recent discovery of mirror neurons, a certain amount of research has been conducted in this field, aiming at uncovering their functions, exact location and evolutionary importance.

One of the main questions related to the role of Mirror Neuron System (MNS) concerns the connection between different aspects of learning and MNS. More precisely, can motor facilitation during action observation act as a predictor of motor learning? In order to answer this question we used Transcranial Magnetic Stimulation technique (TMS) to test the current state of the primary motor cortex.

We divided subjects into two groups, «good responders» and «bad responders», based on the «mirror effect» as measured by Motor Evoked Potentials (MEPs) recorded from the first dorsal interosseus (FDI) as target muscle and the abductor digiti minimi (ADM) as control muscle (not involved in the task movement). Mirror effect was measured as an increase of MEPs amplitude during a hand movement: pinch to grip (not goal-directed) and button pressing movement during the first day session. Stimulation was delivered by navigated single-pulse TMS over the left and right primary motor cortex (M1). Starting from the second day, subjects have been involved in daily behavioral serial reaction time task (SRT) for a total of four days. On the sixth day subjects underwent the same procedure likewise the first day in order to assess possible changes in the "mirror effect" which occur after a motor training.

We expect to see if motor MNS correlate with success rate in SRT learning, i.e. estimate predictive power of MNS in motor training.

Keywords: mirror neurons, motor learning, Transcranial Magnetic Stimulation, movement observation

Levodopa and Deep Brain Stimulation Effects on Noun and Verb Naming in Parkinson's Disease

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Introduction: Action-verb deficit with preserved noun processing is frequently reported in Parkinson's disease (PD). Levodopa (L-dopa) has been shown to ameliorate this deficit. As patients were tested while "on" medication during different Deep Brain Stimulation (DBS) conditions in previous studies, sole effect of DBS on naming is unknown. The aim of this study is to investigate whether L-dopa and DBS improve verb deficit in PD separately.

Methods: Eighteen PD patients with bilateral subthalamic nucleus DBS were included. Nine patients were tested during "on" medication, and nine during "off". Groups were matched on age, sex, years of education, disease duration, Mini Mental State Examination (MMSE) scores. All participants completed a neuropsychological battery consisting of phonemic, semantic and action fluency; Rey complex figure test (RCFT), Trail Making Test-A (TMT-A), State Trait Anxiety Inventory-Y (STAI-Y) 1 and 2; and Beck Depression Inventory (BDI). Then, patients performed picture naming tasks during bilateral off, bilateral on, only left and only right side stimulation. Accuracy and reaction (RT) were analyzed to assess naming performance.

Results: Two groups had similar scores in the neuropsychological battery. Overall, nouns were named more accurately and faster. L-dopa and stimulation conditions did not affect naming performance (Table 1). There were no interaction effects in between the factors.

Conclusion: PD patients have a verb naming deficit, and this impairment is not improved by L-dopa or DBS.

Keywords: Parkinson's disease, noun, verb, levodopa, Deep Brain Stimulation

	Levodopa "on"				Levodopa "off"			
	Nouns		Verbs		Nouns		Verbs	
	Accuracy	RT(sec)	Accuracy	RT(sec)	Accuracy	RT(sec)	Accuracy	RT(sec)
DBS bilateral on	11,6(1,9)	1,37(0,2)	6,3(4,5)	2,07(0,63)	12,1(2,5)	1,38(0,27)	4,4(2,5)	1,65(0,27)
DBS bilateral off	10,1(2,9)	1,44(0,33)	6,3(2,9)	2,00(0,31)	10,6(3,8)	1,27(0,28)	5,7(2,9)	1,87(0,46)
DBS only left side on	10,3(2,8)	1,56(0,51)	5,4(2,1)	2,07(0,45)	11,3(2,7)	1,34(0,43)	6,1(3,7)	1,91(0,79)
DBS only right side on	11,3(2,1)	1,39(0,26)	6,3(2,6)	1,99(0,45)	11,9(3,3)	1,41(0,42)	6,7(3,3)	1,60(0,49)

Table 1. Naming performance of both groups during different stimulation conditions
DBS: Deep Brain Stimulation. All variables are reported as mean (standard deviation).

Meaningless and meaningful training of new words on different task contexts

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Lexical reading is characterized as a direct visual recognition of words with high rates of accuracy and speed. Although the acquisition of this fluent reading mostly depends on the orthographic knowledge about stimuli, training new words at different levels of processing could contribute to the complete lexicalization of these stimuli. The present study compared the on-line brain activity modulations produced by the simple visual exposure to pseudowords to a deeper training strategy in which not only visual but also semantic information about stimuli was provided. Additionally, to test the influence of the training context demands, reductions in the lexicality effect through both meaningless and meaningful training conditions were separately studied in two different tasks, namely in a lexical decision task and in a silent reading task. Modulations on N1/P1 and LPC components were found after simple visual repetition of pseudowords at reading and lexical decision tasks, respectively, showing the enhancement of attentional and episodic memory processes for meaningless repeated pseudowords. On the contrary, pseudoword repetition under the meaningful training condition caused the reduction of differences between these stimuli and real words on the N400 component at both reading and lexical decision tasks, indicating the facilitation of lexico-semantic access to these stimuli throughout this visual and semantic training. Interestingly, a complete reduction of the lexicality effect on the N400 was found in the reading task. This result would indicate the better lexicalization of new stimuli under this task context where conditions were closer to the natural implicit learning of new words.

Neurophysiological differences in processing mathematical and nonmathematical abstract words

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The embodied cognition hypothesis concedes experience a crucial role in shaping conceptual representations. Evidence for this view comes mostly from studies on concrete concepts, where, for example, specialized motor experience of athletes affects the neural processing of action-related words. This study provides complementary evidence about the effects of individual experience on processing abstract words. We asked mathematics experts ($n = 23$) and novices ($n = 16$) to perform a lexical decision on mathematical (e.g., "addition") and nonmathematical (e.g., "intention") abstract words while acquiring event-related potentials. Analyses revealed a complex interaction pattern of Expertise (experts, novices) and Word Type (mathematical, nonmathematical words) arising for the N400 (300-500 ms) as well as for a late positive component (500-700 ms). For both components, comparing the two groups within one Word Type revealed that (i) processing nonmathematical words did not differ in experts and novices, (ii) processing mathematical words differed in experts and novices. Further comparing the two types of words within one group revealed (i) a stronger N400 for mathematical words in novices, (ii) a stronger late positive component amplitude for mathematical words in experts (Fig. 1). This study extends findings on experience-dependent conceptual processing to the abstract domain as the level of expertise with mathematical concepts specifically affected the processing of mathematical compared to other abstract words. Expertise further influenced linguistic processing differentially over time probably reflecting processing performance at different stages of semantic integration.

Keywords: mathematical concepts, event-related potentials, semantic representations, lexical processing, experience.
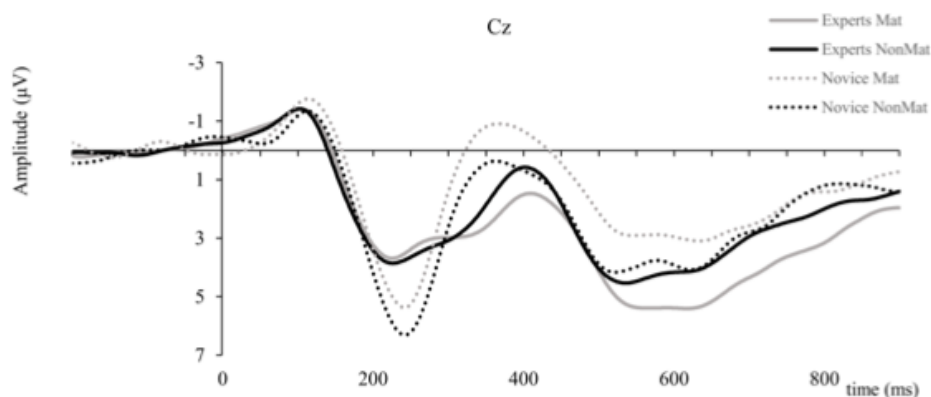
Figure 1. Event-related potentials in the lexical decision task in mathematics experts and novices for the processing of mathematical (Mat) and nonmathematical (NonMat) words, exemplary at electrode site Cz.

Joint action and affordances

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Experiments on joint attention provide evidence, that individuals represent each other's actions. Simon effect was replicated in condition with two participants doing one task with one hand. However, the same results cannot be obtained, when one of these participants does half of the same assignment likewise with one hand.

The stimulus that has been used in the aforementioned experiments (e.g. pointing finger).could provide social context. This leads to the suggestion that joint action might occur due to relevant social stimuli. We argued that effect can be generalized to more abstract spatial stimuli like affordances.

If actions of the coactors are represented by observers, then the effect of joint compatibility should be found without social stimuli. Participants were divided into two groups. In the first group they were completing the task with the partner and the half of the task alone. In the control group participants were completing the whole task on their own. In both conditions they were asked to determine upright and inverted pictures of kitchen utensils by pressing right or left key on the keyboard.

The effect of the affordances has been found in the control condition when participants were performing the whole task alone. Nevertheless, in the experimental condition effect of joint action has not been revealed. Joint performance of the task did not significantly differ from individual execution. It can be concluded, that each other's actions are not represented by coactors in affordances task. More studies are required to show, whether the joint action effect occurs due to the social stimuli.

A perceptually grounded investigation of spatial opposites

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Opposites are pervasive in human thought, as studies in the fields of Philosophy, Logic, Linguistics and Psychology testify. An increase in awareness of the importance of perceptual grounding in language and cognition (e.g., Barsalou, 2010; Bergen, 2012; Gärdenfors, 2014; Pecher & Zwaan, 2005) has given new energy to research into dimensions and opposites (e.g. Kelso & Engstrom, 2005; van de Weijer et al., 2014; Paradis, 2015). What these approaches have in common is a general interest in the perceptual, physiological or neuropsychological grounding of opposition.

We present the methodologies, results and theoretical implications relating to a recent approach to analyzing the structure of spatial opposites based on people's perceptual experiences of two poles (e.g. NEAR/FAR AWAY) and the region that is experienced as intermediate (e.g. NEITHER NEAR NOR FAR AWAY) rather than on traditional linguistic criteria, i.e. whether the adjectives describing poles admit comparatives and degree modifiers such as *fairly*, *very* or *extremely*.

Metric and topological descriptions (Bianchi et al., 2011), classification and rating tasks (Bianchi et al., 2013), response times, eye-tracking and drawing tasks (Bianchi et al., submitted) allowed us to define the nature of the poles and the intermediate regions (either points or ranges) and led to the discovery that identifying intermediates is no more time consuming than identifying poles, and that poles support the identification of intermediate regions as much as intermediate regions support the identification of poles, as shown by eye movement data.

Keywords: opposites, spatial dimensions, poles, intermediates, perceptual grounding.
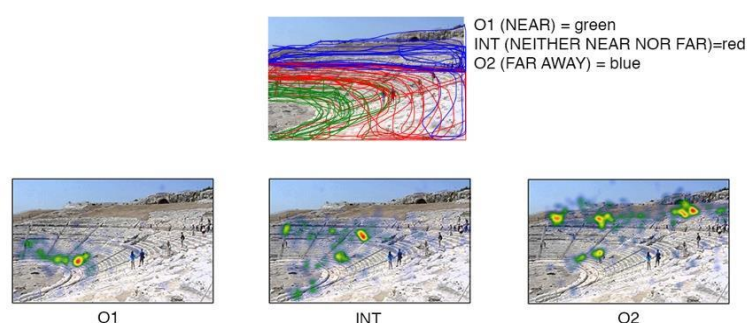

Figure 1 – Example of a drawing task (top row) and eye tracking fixation locations (bottom row) carried out to identify NEAR (O1) – NEITHER NEAR NOR FAR AWAY (INT) – FAR AWAY (O2) with respect to a stage in a theatre.

The role of visual context for identifying generics in aphasia

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Sensitivity to generic-nongeneric distinction seems crucial for everyday speech. To interpret an utterance generically or non-generically English speakers rely on three types of cues – morphosyntactic , contextual and world knowledge (Gelman and Raman, 2003). However, we still do not know whether and to what extent this competence is preserved in linguistically impaired population.

The present study tests the findings of Gelman and Raman (2003) for two Russian speaking populations: healthy adults and adults with aphasia (semantic, motor, dynamic – according to Luria's classification). Both groups of participants were shown pictures with animals that have unusual visual features and then asked questions about the animals (i.e., *Это верблюд. У верблюдов зеленый горб? 'Here is a camel. Do camels have green hump?'*). In half of the stimuli the number of creatures in the picture mismatched with the number of the noun in the question, which should force generic interpretetion. We found that healthy adults are sensitive to switching of morphosyntactic cues: in the mismatch condition they interpret the question generically (62% generic interpretations in mismatch conditions and 28% in match conditions). Patients chose generical interpretation regardless conditions (74% of generic interpretations in match conditions and 75% - in mismatch conditions). We suppose that participants with aphasia ignored pictorial context and morphosyntactic cues and relied on their world knowledge.

Keywords: genericity, aphasia, neurolinguistics

The Role of Eye Movements in Situated Spatial Language Comprehension

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A spatial description such as "the key is *on* the table", describes the location of the key (the located object) in reference to the table (the reference object). Such descriptions are ordinarily produced also when the located object is not directly visible. This observation seems to be in contrast with those studies showing that in order to process a spatial relation people need to shift their attention between the objects (Yuan, Uttal, Franconeri, 2016). How can a speaker shift the attention between two objects if one is not visible? In the current study we tested the hypothesis that object locations are rapidly stored via spatial indexing (Pylyshyn, 1989) and that the spatial representation built up on this information allows people to extract the spatial relation without shifting their attention between the objects. Participants performed a matching task (see Figure 1) while monitoring eye movements together with briefly presented stimuli prevented them from moving their eyes on the stimuli. Preliminary data analysis revealed that, even under such constrains, participants were able to process the spatial relation with high accuracy (85%, $\chi^2(1) = 1226.1$, $p < .001$) and that the correct matching pattern was selected significantly more frequently than the chance level ($\chi^2(3) = 1907$, $p < .001$). This outcome indicates that spatial relations can be extracted without shifting the attention between the objects and suggests reconsidering the role of eye movements in the understanding of spatial language. A revision of the linking hypothesis in the understanding language comprehension is also demanded.

Keywords: spatial language, eye movements, attention, linking hypothesis, spatial relations
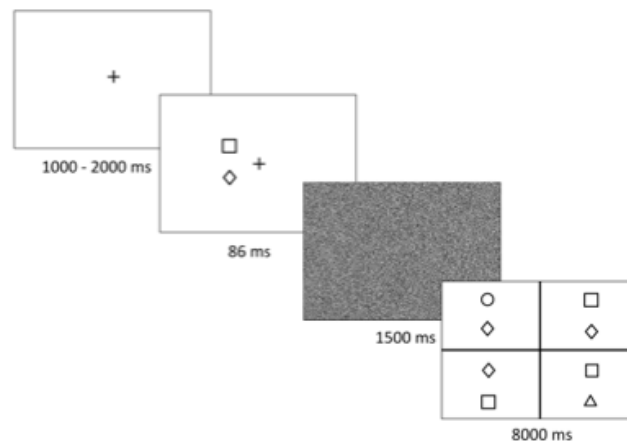

Figure 1: Participants were briefly presented with a target pair of objects while their eyes were monitored to assure they did not shift their attention directly on the stimuli. After a backward mask participants were presented with four pairs of objects and were expected to find the matching pattern (top-right quadrant). Note that the correct pattern could be matched only by processing the spatial relation between the two objects.

Phonological working memory affects the time of solving of logical tasks for arithmetical sequences

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Capacity of working memory (WM) is well known to influence mathematical abilities. This effect is more profound for visual-spatial WM domain while phonological loop has no or little effect on mathematical abilities in adults. However, the role of the brain language network at mathematical cognition is still under discussion. We examined the effect of WM in phonological loop using a simple forward digital span test at the speed and correctness of solving different mathematical versus verbal tasks in healthy right handed young volunteers with higher education in math (N=10) and in humanities (N=10). The correctness (C) and time of the task solving (TS) was significantly better in Math group than in Humanitarian group of subjects. The WM factor didn't affect either C or TS in all subjects or comparing the groups. Remarkably, the WM correlated negatively only with TS of logical task for arithmetical sequences in both groups. The separate group analysis showed that WM affected the C of solving the mathematical tasks in math group but not TS while in humanitarian group we observed the opposite tendency. The influence of WM on C of solving the verbal tasks showed no effect in math group but correlated significantly with the amount of unsolved tasks in humanitarian group. Our results imply that WM in verbal domain may influence mathematical abilities especially when they require involvement of logical thinking. However, the correlation of these processes with verbal skills is indirect. This work is supported by the grant of RFBR No 17-06-00918.

Keywords: Working memory, phonological loop, mathematical tasks, verbal tasks

Acquiring of new word meaning by auditory-motor associations in trial-and-error learning paradigm[5]

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According to the embodied cognition theory, speech is largely based on the body motor and sensory experience. The question, which is crucial for our understanding of the origin of language, is how our brain transforms sensory-motor experience into word meaning. We have developed an auditory-motor experimental procedure that allowed investigating neural underpinning of word meaning acquisition by way of associative "trial-and-error" learning that mimics important aspects of natural word learning. Participants were presented with eight pseudowords; four of them were assigned to specific body part movements during the course of learning – through commencing actions by one of participant's left or right extremities and receiving a feedback. The other pseudowords did not require actions, and were used as controls. Magnetoencephalogram was recorded during passive listening of the pseudowords before and after learning. The cortical sources of the magnetic evoked responses were reconstructed using distributed source modeling (MNE software). Neural responses to newly learnt words were significantly enhanced as compared to control pseudowords in a number of temporal and frontal cortical regions surrounding the Sylvan fissure of the left hemisphere. Learning-related cortical activation was inversely related to the number of trials needed to acquire the word meaning (this value varied between participants from 74 to 480 trials to the learning criterion). Our findings revealed a neural signature of associative transformation for association-grounded word semantics.

Keywords: embodied cognition, action words learning, cortical plasticity, MEG, speech learning.
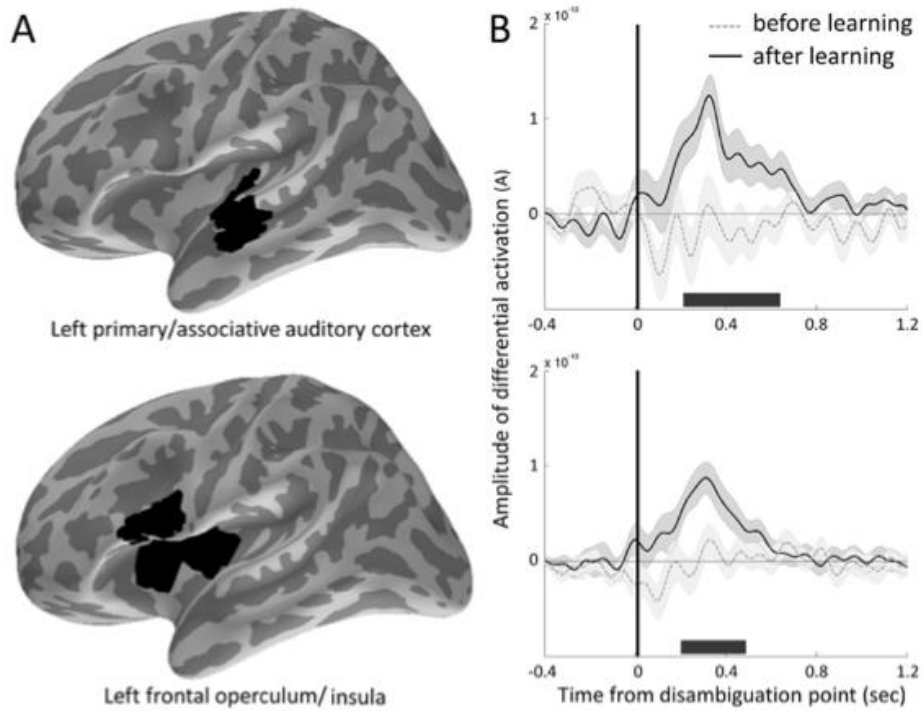

Figure. Spatial clusters (A) and timecourses (B) of learning-related activation. Activation sources are shown for significant difference in activation between meaningful and meaningless pseudowords before and after learning. Bars beneath each timecourse indicate the time windows for which differential activation in the respective cluster was significant. Vertical lines denote the word disambiguation point ("0"), after which meaningful pseudowords started to differ from controls. Shaded areas represent the standard error of the mean.

The co-evolution of language and object throwing in hominins

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Language has a multiplicity of uses for humans today and many causes have been posited for its origin, e.g. tool use, information transmission, social interaction, abstract thought. In 1982, the neurophysiologist WH Calvin proposed a novel hypothesis for the origin of language capacity in hominins: Morphological adaptations for arboreal living in ancient apes were exapted for object throwing and led to the emergence of hominins as an action-at-a-distance predator. Throwing accurately however requires precise timing in the coordination of various effectors, placing a strong selective pressure for multiple morphological changes including more neurons and increased encephalisation. These timing requirements are similar to those required for speech and Calvin hypothesised that the neural mechanisms which supported this timing in throwing were then exapted for language.

Calvin's hypothesis has never been experimentally tested in humans. Multiple recent strands of paleoanthropological, archaeological, genetic, linguistic and psychological research indicates both language and throwing are more ancient than previously thought. Moreover, evidence for throwing behaviours often predates evidence for language. Many researchers are understandably sceptical of the potential pitfalls of such investigations, especially the creation of just-so stories. However, if language is viewed as an embodied activity rather than a mental process, then both speaking and throwing can be viewed as the activities of organisms and become open to investigation in a similar manner to any other behaviour.

This talk will explain Calvin's hypothesis, highlight recent language and throwing evolution research, make a case for its investigation and outline a specific experimental method combining linguistics and movement science.

Keywords: evolution of language, evolution of throwing, hominin evolution, experimental psychology, embodied cognition

Date	Species	Language relevant morphology	Throwing relevant morphology	Throwing technology & meat eating
4.4Mya	*Ardipithecus*	unknown	Hand structure enables power grip but weak thumb	
	ramidus	Partially bipedal	Partially bipedal	
3.2Mya	*Australopithecus*	Ape-like hyoid bone	Hand structure enables power *and* throwing grips	
	afarensis	Fully bipedal- decoupling of	Fully bipedal - decoupling of waist and throax	2.6Mya Regular meat eating and first
		breathing and locomotion	Low humeral torsion	appearance of stone tools
			Partially laterally oriented glenohumeral joint	
1.9Mya	*Homo erectus*	Archaic hyoid bone (possibly air	Fully modern human power and throwing grips	1.9Mya Intensification of meat eating
		sacs attached) limited vocal range	Fully bipedal - decoupling of waist and throax	1.8Mya Ball-shaped stone objects
		Middle-ear audiograms within	Lowest humeral torsion	with throwing affordance properties
		normal human range in late	Fully laterally oriented glenohumeral joint	become widespread in hominin sites
		specimens		
		Narrow thoracic vertebral canal		
		Fully bipedal		
.5Mya	*Homo*	Modern hyoid bone	Fully modern human power and throwing grips	400kya Indirect evidence of
	neanderthalensis	Middle ear audiograms within	Fully bipedal - decoupling of waist and throax	thrown spears
		normal human range	Higher humeral torsion	279kya Direct evidence of
		Enlarged thoracic vertebral canal	Fully laterally oriented glenohumeral joint	thrown spears
		Fully bipedal		

Cognitive training with action verbs induces neural plasticity in the motor system

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Embodied cognition theories of semantic memory still lack sufficient evidence of causality in support of the involvement of sensory-motor systems in action-related knowledge. Partial evidence of causality exists, showing that training manual actions improves semantic processing of verbs referring to the trained actions. The present work provides complementary evidence by measuring the brain plasticity effects of a cognitive training consisting of language and memory tasks. Two groups of participants (n=10 each) were trained with verbs referring to actions involving the proximal (P-Group) and the distal (D-Group) arm musculature, respectively. Before and after training, we measured gray matter voxel brain morphometry (VBM) based on structural magnetic resonance imaging. By means of this 2 (P-Group, D-Group) x 2 (pre, post-training) factorial design, we tested whether sustained cognitive experience with specific musculature-related verbs induces congruent brain plasticity modifications in target Regions-Of-Interest. Based on previous VBM studies on motor training (Dayan & Cohen, 2001), we targeted fronto-parietal cortices, constituting the action representation system, and the cerebellar lobule VII, as a structure engaged in fine motor manipulations. Results revealed significant ($p<0.05$ FWE-corrected) post > pre-training gray matter volume increases for (i) P-Group > D-Group in the left dorsal precentral gyrus; (ii) D-Group > P- Group in the right cerebellar lobule VIIa. We found no effects in control regions, namely the linguistic, musculature-unspecific pars opercularis, and the non-motor posterior cingulate. We suggest that a cognitive training can induce plasticity modifications in sensory-motor brain regions specifically controlling the musculature involved in the actions the trained verbs refer to.

Keywords: semantic memory, embodiment, action-related verbs, training, gray matter brain morphometry
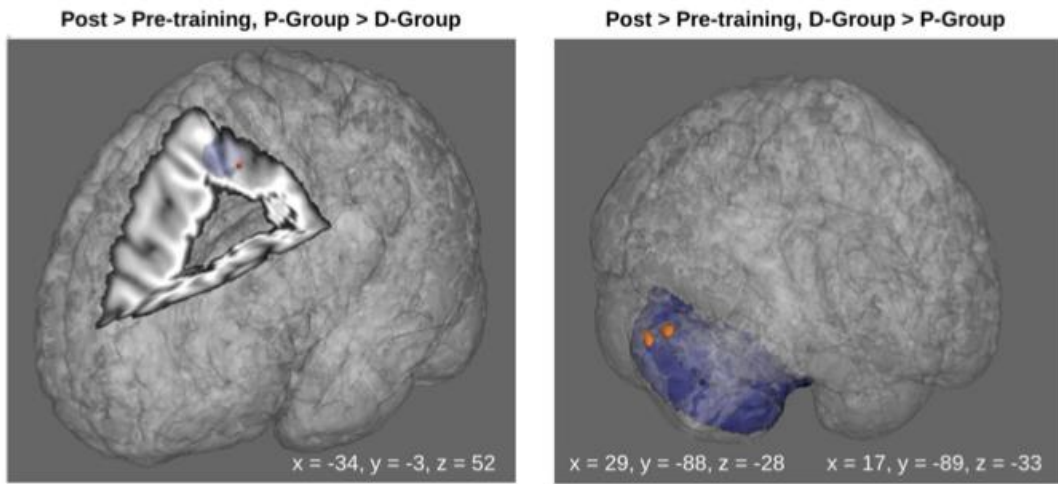
Figure 1. Post > pre-training gray matter volume increases for P-Group > D-Group (left) and D-Group > P- Group (right). Red: significant clusters (p<0.05 FWE corrected); blue: ROI. MNI coordinates are reported.

EEG data on the differences in the success of thinking, depending on various instructions

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In this EEG study, we observed the success of thinking depending on different instructions. Subjects (n = 20) were provided with the "Generalization of three words" (Kholodnaya, 2012). It is necessary to combine three words, calling an essential significance. In the process of solving tasks, we registered the EEG.

The subjects were divided into two equal groups (10/10). 10 participants were informed that the first three samples would be training, and subsequent samples would be evaluated. Another 10 subjects were not informed of this information. The answers were estimated from 0 to 2. The total number of successful answers was calculated for each subject.

It was shown that in the case of a successful response, the fractal dimension of the EEG data (D0) decreases (calculated by the Higuchi algorithm (1988)). Subjects who scored more successful answers made mistakes when they were given the opportunity to train. After that, they often gave a successful response. In the event that the subjects were not given additional information about the tasks, they often made errors randomly. Less successful subjects allowed random answers to errors, regardless of the instructions (F=12,137, p<0,0005). As a result, we found that in the case of a successful response, the fractal dimension of the EEG decreases, as confirmed by our previous results (Scherbakova et al.,2014,2016; Golovanova, 2016).

Keywords: thinking, EEG, instructions, problem solving, fractal dimension

Why religious faith is up? Associations between Tibetan Buddhism and vertical position

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Prior research reveals that the encoding of divinity-related cognitions or affect link to vertical metaphors(e.g., "God is up" , "up" for good words), suggesting the association between religious concepts and vertical position may exist. To our koowledge, no study to date has used a sequential priming paradigm to examine the vertical metaphor of Tibetan Buddhism. The present studies extend this view by investigating whether such biases also adapt to Eastern religious faith-Tibetan Buddhism. Specifically, in two studies, we examined whether the representation of religious concepts depend on metaphor, as well as the directional of this relationship across a cohort of indigenous Tibetan subjects. The results of Experiment 1 revealed that indigenous Tibetan subjects encode the letter "p" or "q" in the up faster following religious-related concepts than neural-related concepts, showing that evaluations bias spatial attention in a metaphor-consistent direction(e.g., ''religious concepts'' activates ''up'').The results of Experiment 2 showed that indigenous Tibetan subjects encode religious concepts in the up faster following the letter "p" or "q" in the up than in the low, suggesting that the activation of areas of visual space does also prime evaluations (e.g.,''up'' does activate ''religious concepts ''). These studies suggest that reigious concepts has a surprisingly physical basis, as well as the symmetrical nature of religious metaphor.

Keywords: vertical metaphor, religious faith, tibetan buddhism, religious artidacts, embodied cognition
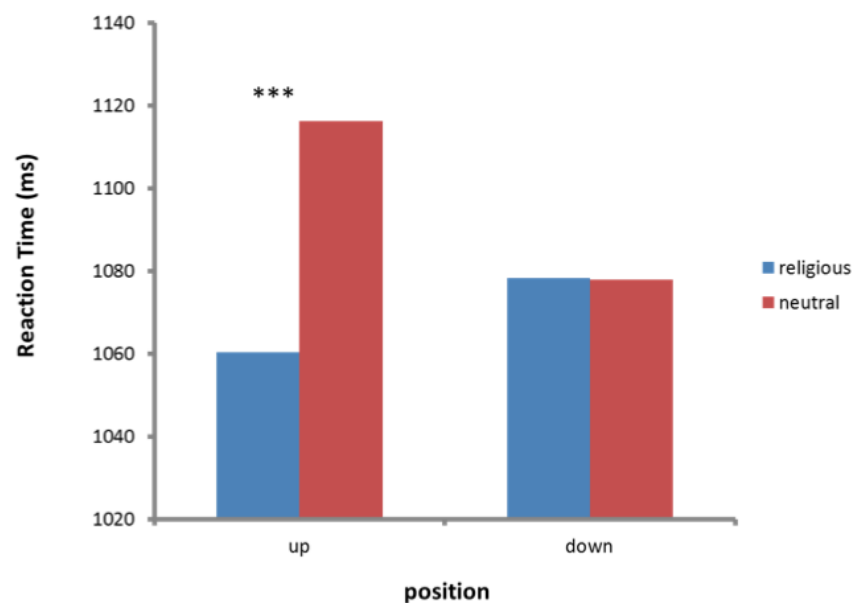
Figure 1. Reaction time during the sequential priming paradigm in Exp.2.

Simulating Distributed Cognitive Engroupment in the 2011 Tahrir Square Protests

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Inspired by the ongoing work of Gareth Roberts in the field of experimental semiotics in language change studies (Roberts et al. 2015; Roberts and Gareth 2012; Galantucci et al. 2012), I developed a computerized model that simulates several of the most prevalent communicative strategies used in the 2011 Tahrir Square revolution in Egypt. The model automates the relative 'conversion efficiencies' of several prevalent *communicative channels* used in initiating newcomers and coordinating the Tahrir protests. Various channels were involved in initiating newcomers into 'protest formations' and eventually, through engroupment processes, into the larger-scale revolutionary formation. Different channels were also deployed for coordinating the formations throughout the many levels and stages of engroupment that resulted in the meta- system observed during the 18 Days of Tahrir. My argument is that the individuals who make up the sub-groups, member networks of protest formations, and the overarching revolutionary formation were coordinated by self-organizing intergroup principles best understood in terms of distributed cognition. Furthermore, the main finding produced by the model is that the extent to which the social processes of individuals and smaller groups joining larger groups and forming temporary alliances - what I call 'engroupment' - is present significantly alters the outcome of the revolution in each round. Without engroupment, the pro-revolution Tahrir group fails. With engroupment, it has a greater chance to succeed. The simulation was developed in a Java-based programming environment called Eclipse. An animation engine was installed from an available Java API library called Processing and coupled with GraphStream to build much of the geometry needed to model the sociolinguistic ecology described in this paper. The simulation includes representations of individuals, or 'independents', sub-groups, sub-networks, protest formations, and each round composes a meta-systemic revolutionary formation.

An ecologically-inspired real-time visual feedback training system to support novel vowel production

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During infancy, the explosion of possibilities afforded by increasing control over language resources are paradoxically accompanied by a significant narrowing of flexibility when it comes to the building blocks of speech itself. Powerful perceptual biases are at play before we can produce words, directing attention towards a native phonology which ultimately constrains the sounds that come to auditorily define us in the world. For these reasons, second language learners struggle to develop novel accents without influence from their native tongue and demonstrate poor perceptual discriminability and categorisation of non-native sounds (Best, 1995; Flege, 1995).

Augmented feedback systems employed for speech-training frequently include rich anatomical, or abstract acoustic feedback which fail to appreciate the tight coupling of perception and action, yielding displays that are difficult to interpret and use. This talk considers the motivation and design for a feedback system providing real-time information on novel speech-sound production along task- relevant perceptual dimensions.

An ecological approach characterises the linguistic entities to be learned as vocal tract gestures (e.g. Fowler, 1986) and proposes that the learning process involves both action execution and exposure to relevant perceptual control information. This feedback is a simple 2D visual display in which speakers' productions are represented by a continuously moving dot which they must drive towards a target, taking advantage of the mapping between tongue position and vowel formants.

With small periods of training, augmented access to speech gesture information is fast and effective at driving and stabilising production. Crucially, these gains hold in the presence and absence of feedback. This work acts as a proof-of-concept of the power of the ecological approach to increase our theoretical and practical understanding of speech-sound acquisition.

Keywords: Speech training, augmented feedback, phonetic perception, language acquisition, ecological psychology
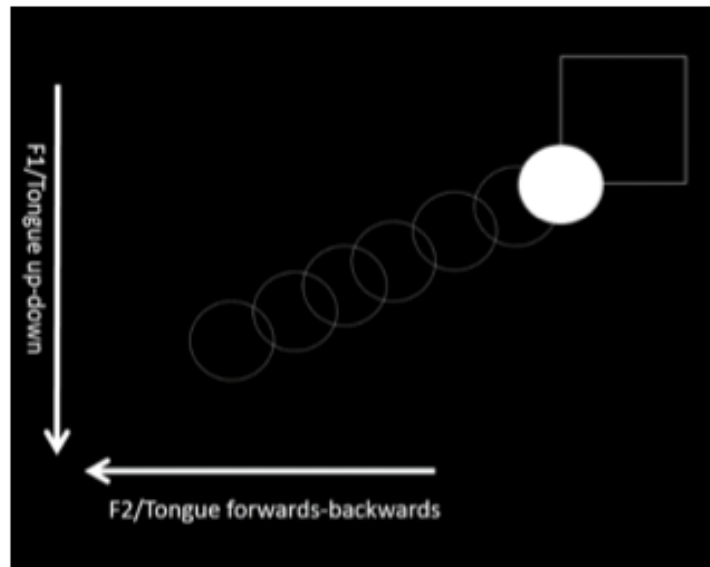
Figure 1. Continuous visual feedback of vowel production (moving dot) in F2-F1 space with respect to a static vowel target (square) - axes and dot trace for illustration only
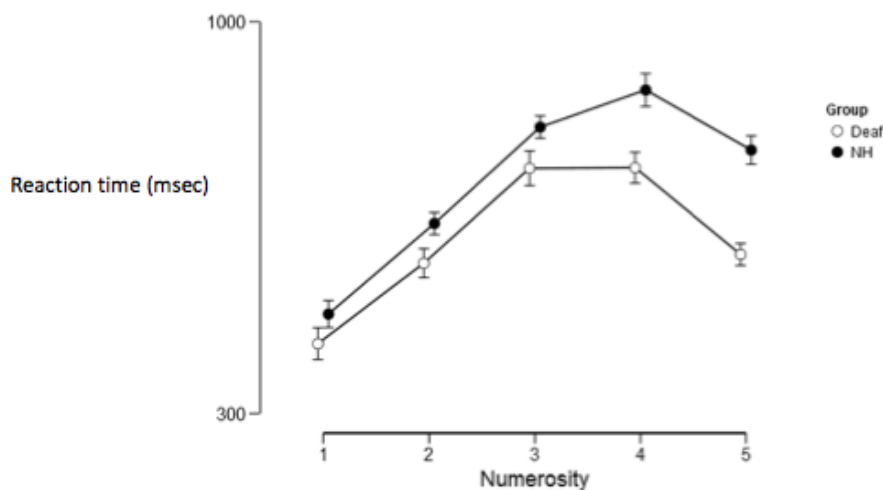
Embodied enumeration among the deaf

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The representations of fingers are embodied in our cognition and influence performance in enumeration tasks. Among the deaf population, fingers are also a tool for communication in sign language, which conveys embodied representations as well. Previous studies in normal hearing (NH) participants have shown behavioral embodied effects such as faster counting of finger counting schemes and an embodied automatic end effect (AEE) using a passive tactile enumeration task. In this study, we examined to what extent the shared use of fingers for counting and sign language manifests in embodied mental representation. In order to do so, we used three enumeration tasks in two ranges (1-5 stimuli, 1-10 stimuli): passive tactile enumeration, dot counting, and comparative dot counting. Preliminary results showed faster counting in the deaf group and stronger AEE compared to the control group in the tactile domain. The exclusiveness of the results in the tactile domain emphasizes the influence of embodied representation in the deaf group, an effect that has not been studied adequately. In addition, the current study provides further evidence for a sensual tactile advantage among the deaf group - a topic that is still controversial.

Keywords: numerical cognition, deafness, tactile enumeration, sign language, finger counting

Mean Reaction times for counting 1-5 tactile stimuli on one hand

Verbal fluency declines in Parkinson's disease patients with STN-DBS: combining MEG and tractography

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Deep brain stimulation (DBS) of subthalamic nucleus (STN) effectively alleviates motor symptoms in advanced Parkinson's disease (PD) patients when dopaminergic medication is no longer an adequate treatment. Some patients may, however, experience mild adverse cognitive effects from the treatment. One of the most often reported adverse cognitive effects is a worsening of verbal fluency (both phonemic and semantic). The underlying mechanisms of this decline are still not well understood. In assessing the evidence for different putative explanations, our group recently concluded that either the stimulation itself (and thus electrode positioning) or lasting ablations from the surgery were the best candidates for potentially explaining the reported declines.

Though highly relevant in neuropsychological assessments of patients, the verbal fluency task is a multi-faceted task involving a multitude of cognitive processes including lexical search, memory retrieval, and response monitoring and selection. Hence, experimental investigations into the underlying causes of the reported verbal fluency deficits after DBS are not easily amenable to standard experimental paradigms. Here, we present a novel experimental design for investigating potential verbal fluency deficits in DBS-treated PD patients using MEG and tractography, as well as highlight some of the methodological difficulties of investigating this clinically relevant, but cognitively multi-faceted, task. These include, among others, using objective measures of the switch processes involved in the verbal fluency task in order to guide source localization of prefrontal source activity (dorsolateral prefrontal cortex, dlPFC) as a potential marker for verbal fluency difficulty.

Keywords: verbal fluency, Parkinson's disease, deep brain stimulation, MEG, tractography

Engagement of the Primary Sensorimotor Cortex in the Processing of Literal and Metaphorical Meanings

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The grounded cognition hypothesis is based on the notion that our mental representations are influenced by our experience in the physical world. Within this theory, it has been implied that the sensorimotor cortex plays a specific role in the processing of the verbs of movement related to different body parts. Namely, this area is active in a somatotopic manner in addition to other regions activated during speech production and comprehension when processing verbs of movement of hands and feet. In the current study, we conclude an fMRI experiment in order to investigate whether and how sensorimotor cortex is involved in the processing of motion verbs in their literal ('throws a ball' - 'brosaet' myach') and metaphorical ('throws a glance' - 'brosaet' vzglyad') meaning among Russian speakers. As the main method of our research we compared activation acquired during the processing of verbs of movement in their literal and metaphorical meaning with regions of interest in the sensorimotor cortex that are active during hands or feet movements. The results of the ROI analysis executed using three-way repeated measures analysis of covariance (ANCOVA) suggest that the sensorimotor cortex areas that are involved in hand movements are also involved in the processing of both literal and metaphorical meanings of verbs related to hand action and movement, while the areas involved in feet movement failed to show the same pattern of activation in the corresponding feet movements region of interest. The results of this work provide an interesting topic of discussion in terms of the theory of grounded cognition as well as several linguistic theories, including the theory of cognitive metaphors.

Keywords: grounded cognition, sensorimotor cortex, action and movement, metaphor, ROI analysis

Language Functions in Adults with Schizophrenia and Normal Controls

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Background: Emerging linguistic evidence points at disordered language behavior as a defining characteristic of schizophrenia. Schizophrenic patients perform specifically poorly on tasks using verbal, rather than non-verbal tests. Verbal communication is one of the common impairments of several diagnostic characteristics of schizophrenia.

Objective: The aim of the study was to assess the difference between schizophrenia patients and normal subjects with regard to language related cognitive dysfunctions.

Method: The study participants consisted of 32 adults with schizophrenia (mean age, 29.69 ± 4.51; age range, 16–62), and 31 normal control subjects (mean age, 31.39 ± 5.16; age range, 15–60). The sample of schizophrenia patients was recruited during the years 2014-2017. The NIMHANS Neuropsychological battery was administered to understand the language related cognitive profile of the subjects. The battery comprises of 6 tests, which assess the aspects of attention, mental speed, comprehension, executive functions, verbal learning and memory. These subjects were referred to Bangalore Neuro Centre, Bangalore, India from the community. Statistical analysis was performed using one-way Analysis of Variance (ANOVA) to compare the mean difference between schizophrenia patients and normal control subjects.

Results: The findings revealed that there exists a significant difference between patients with schizophrenia and normal people in terms of neuropsychological scores in language and verbal functions in all 12 variables. Patients with schizophrenia had higher impairments and depression when compared to normal people.

Conclusion: The normal control subjects who performed high in cognitive functions reported lower level of depression. The findings of the present study signify that there are differences in neuropsychological variables (executive functions, verbal learning and memory) between schizophrenia patients and normal control subjects.

Test Variables	F	Level of significance	Test Variables	F	Level of Significance
Verbal Fluency	211.88	0.01	Auditory Immediate Recall	10.16	0.01
Stroop Word	35.92	0.01	Auditory Delayed Recall	7.88	0.05
Stroop Colour	84.42	0.01	Colour Trails-I	107.73	0.01
Stroop Effect	109.28	0.01	Colour Trails-II	195.48	0.01
Stroop Interference	84.85	0.01	Animal Fluency	12.44	0.01
Auditory Learning	12.21	0.01	Digit Symbol	374.31	0.01

Keywords: schizophrenia, language processing, cognitive dysfunctions, depression, normal controls

Spontaneous retrieving vs. forced concepts in concept maps of novices and experienced students

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Background: Concept maps are a widely used research method for investigating knowledge structure. A concept map is a graph in which the nodes represent concepts, the lines between nodes represent relations, and the labels on the lines represent the nature of the relations. There are two main approaches to constructing concept maps: the concepts to map may be predefined for respondents (forced concepts) or the concepts may be retrieved by the respondent from memory (spontaneously retrieved concepts). The issue is that possible differences may exist between the maps constructed with these two approaches and interpretation of these differences. Previous studies have been focused on differences in maps with forced vs. retrieved links or labels of links when the concepts were specified beforehand (Ruiz-Primo et al, 2001; Yin et al, 2005). However, it has not been investigated what the differences between concept maps are if respondents use forced concepts or spontaneously retrieve them. Also it is not clear to what extent background knowledge can smooth these differences.

Current research questions: We are going to examine features of concept mapping both with and without predefined concepts (that is spontaneous vs. forced maps). Based on studies in conceptual knowledge representation especially the theory of "schema" (e.g., Rumelhart, 1980; Anderson, Pearson, 1984) we hypothesize that spontaneous maps will be more diverse across respondents than forced maps, which are expected to be more homogeneous. Also we suppose that background knowledge in a particular domain will affect divergence across both forced and spontaneous maps.

Method: Students with different level of background knowledge in statistics participated in the study. Participants constructed two maps with an interval of three weeks. First, they drew spontaneous maps for the statistical analysis domain. Second, participants constructed maps using concepts which experts had noted as the most significant. The number of concepts links and proportion of correct links as well as qualitative features of map organization (for example, hierarchical structure or cycles) will be analyzed.

Expected results and Discussion: We expect that for the novices in the domain spontaneous maps will differ significantly while experienced students will produce more homogeneous maps. Contrary to this, variability of forced maps is supposed to be less affected by the level of expertise. The results will be discussed in terms of testing some predictions from theories of schema as well as the validity issue of concept mapping.

Keywords: concept maps, cognitive structure, statistic.

Situational construction of a semantic meaning as first-order languaging

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The paper is to distinguish between the concrete bodily-wordly activities that we engage in as we communicate and the virtual patterns of words and morphemes that we experience during such activities. The former constitutes our first-order languaging, while the latter is a second-order language with a slogan, language is "dynamics first, symbols afterwards" (Cowley, 2009: 504). Languaging (first-order constraint) in everyday speech is natural and biological, it is about how people live, co-ordinate each other, do things together and share language environment.

The current meaning of a linguaform depends on the interaction with the agent-environment system (agent of this linguaform, the speech context, sensory stimuli – variations of (voice) pitch contour, volume, lengthening, gesturally by posture and limb, facial display and so on). As Zlatev argues (2003), during communication, every actual meaning corresponds to a change brought about in a relevant actual state of the body. To understand the meaning of the word we do not operate with pre-given meanings (input-output structures) but rather generate it "here-and-now". The meaning of a word is situationally realized at the moment of speaking on the basis of the context and the lexical prototype (as part of our general experience with the word) and is made every time anew. Communicating we strive for adaptation, establishment of a consensual domain of interactions (coherent and harmonic relations with another speaker to reach understanding).

Keywords: semantic meaning, first-order languaging, second-order language, lexical prototype.

Expertise and Cognition: Semantic processing in athletes, musicians and controls

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Investigation of expertise in sport and music has identified cognitive and neuroanatomical adaptations resulting from practice, including increased cortical representation and efficiency of networks also recruited by language processing and sensorimotor simulation, e.g. Broca's area and the motor cortices. Thus, the current research aims to explore lexical and semantic ability in athletes, musicians, simultaneous experts and a control non-expert sample. Expertise is expected to result in enhanced performance. Four language classes are employed, with differential advantages based on expertise-type: shared for hand; full-body for sport and simultaneous experts; auditory for music and sport-and-music; no differences for abstract verbs.

The study used a 4x4 mixed design to compare language performance according to expert status, stimulus modality and their interaction. Participants included 78 volunteers with a mean age of 25.21 years (SD=7.82). A computer-based paradigm produced two tasks: lexical decision between words and pronounceable non-words, and semantic similarity judgment. Each tasks consisted of 40 trials, 10 per modality. Four mixed linear models investigated accuracy and reaction time on both tasks separately. Expert grouping revealed no significant effects on any measure. Significant main effects of modality and interactions were found on lexical and semantic response speed, primarily distinguishing auditory from other classes.

These findings are interpreted in two directions: methodological limitations in engaging specific language networks primed by music and sport practice, and; differential comprehension stages of verb classes. Future explorations are suggested to address definitions of expertise, task sensitivity and comprehensive control of stimulus properties.

Keywords: embodied cognition, language, language priming, music expertise, sport expertise

Language background and orthographic manipulations of the color-word Stroop

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Color-word Stroop task is widely used measure of executive function and reading automaticity. Some studies show that speaking another language has an effect on Stroop performance, whereas others show no relation. Moreover, a word's readability may be affected by orthographic manipulations. The purpose of this study is to assess the relation between language background and orthographic manipulations in the color-word Stroop. We will present data on young adults (n = 50; 20-30 years; ~50% females) who speak Russian and English. Language background will be assessed using the Language and Social Background Questionnaire. Participants will also complete a classic paper version of the Stroop task in Russian and English and a modified computerized version that manipulates color-word orthography in Russian and English (*Figure 1*). Bivariate ANOVA will be used to test effect across conditions. To examine the relation between language background and interference multiple comparison-correlational methods with Bonferroni correction will be used. We hypothesized that in stable bilinguals interference will be lower and therefore they will show faster reaction than unstable bilinguals. Knowledge from the work will contribute to our understanding of the effect of language background on executive function.

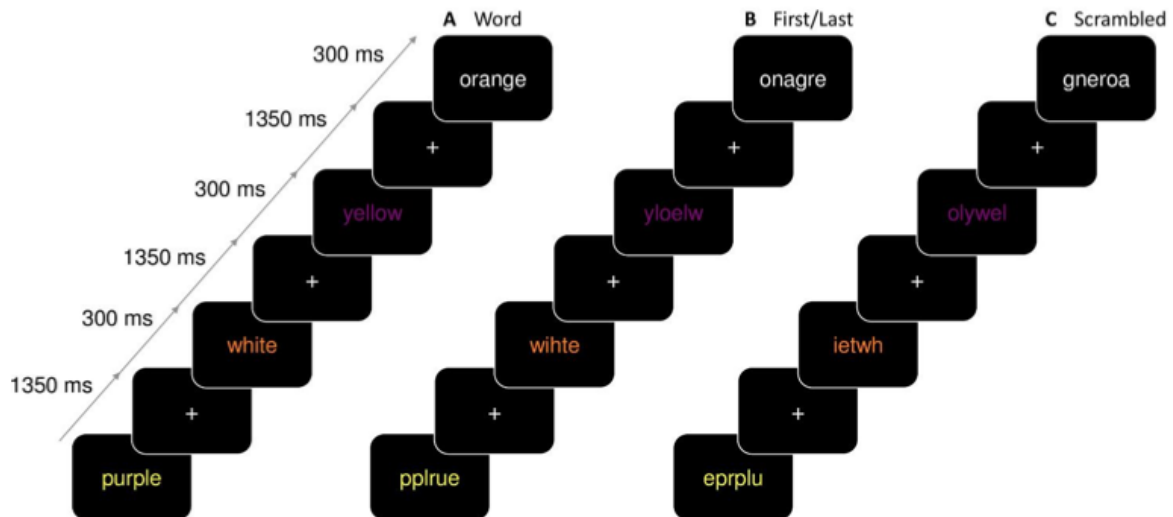**Keywords:** color-word Stroop, language, bilingualism, orthographic manipulation, interference

Figure 1. Examples of word-types for incongruent conditions:
(A) Color words, (B) Scrambled color words with the first and the last letters in place and (C) Scrambled color words.

Body-specificity hypothesis with a finger move: Evidence from a colour categorization task

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According to the body-specificity hypothesis (Casasanto, 2009) if people have different bodies and interact with the environment differently, they should also think differently, constructing different mental representations even of abstract concepts such as *good* and *bad*. Casasanto (2009) showed a tied relationship between handedness and mental representation of positive and negative concepts: right-handed associate good concepts more with their right space, and bad concepts – with their left space while the opposite pattern was observed with the lefthanders. We tested whether the space-and-concept-valence association could still be observed within a tiny space with fine left/right finger movements. A modified version of a paradigm used by Khalid and Ansorge (2013) was employed. 17 right- handed participants had to press a button in response to ink colour of adjectives denoting positive or negative concepts. The buttons were of the numeric keypad of a standard keyboard (#4/left, #6/right). In addition, after the response, they had to return to the 'starting mid-point', #5. The participants used only their index finger. The results showed a significant interaction only on the 'return' RT: The effect of finger move was evident for *bad* concepts but not for *good.* When participants had to move their finger to the right (returning from #4), they were slower after the *bad* concept than when they had to move the finger to the left (returning from #6). The results of a non-semantic task showed for the first time that even a tiny finger movement could reflect the specificity of mental representation of abstract concepts.

Keywords: embodied cognition, body-specificity hypothesis, abstract concepts, finger motor response, RT.

The Effect of Phonological Ambiguity of Gender Morphemes on Anticipatory Eye Movements

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Gender morphemes on adjectives have been shown to facilitate the retrieval of an upcoming noun in the unfolding speech stream (Dahan et al, 2000; Sekerina, 2006, among others). We use the Visual World paradigm to study how this facilitatory function of gender morphemes is affected by their phonological ambiguity during lexical retrieval in Russian native speakers.

Russian has a three-way gender system where masculine gender morphemes on pronouns and adjectives are always phonologically unambiguous (clearly perceived as masculine), while feminine and neuter morphemes can be both unambiguous (clearly either feminine or neuter) or ambiguous (potentially perceived both as feminine and neuter) (Table 1). We seek to establish whether phonologically ambiguous morphemes on pronouns and adjectives activate feminine or neuter gender nouns. Is there a systematic shift towards an activation of nouns of one of these genders or are nouns of both genders activated in an arbitrary manner?

We tested eye movements of twenty-four Russian native speakers as they saw objects on the screen and heard questions about one of the objects. Preliminary analysis of the data shows that gender morphemes on pronouns did not facilitate lexical retrieval, but gender morphemes on adjectives did. Moreover, participants often fixated longer on and made more saccades to gender congruent objects if the morpheme was unambiguous, which indicates that phonological (un)ambiguity is relevant for the facilitatory function of gender. Finally, ambiguous gender morphemes did not activate feminine gender nouns more often than neuter gender nouns, despite the higher frequency of feminine nouns in Russian.

Keywords: Visual World, gender, Russian, lexical retrieval, phonological ambiguity

Table 1. Ambiguous and unambiguous gender morphemes in masculine, feminine and neuter genders on demonstrative pronouns and adjectives in Russian

	Masculine	**Feminine**	**Neuter**
Unambiguous gender morphemes on **pronouns**	э́тът (this)	N/a	N/a
Ambiguous gender morphemes on **pronouns**	N/a	э́тʌ (this)	э́тʌ (this)
Unambiguous gender morphemes on **adjectives**	бʌл'шoj (big) кра́сны³j (red)	бʌл'ша́jъ	бʌл'шój ъ
Ambiguous gender morphemes on **adjectives**	N/a	кра́снъjъ	кра́снъjъ

ERP-markers of verbal antilogies comprehension in people with various IQ levels

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We aimed to find out whether there were any differences between ERP- markers of verbal antilogies comprehension in participants with various levels of IQ. At the first stage of the study, we used Raven's "SPM" test to assess the IQ of the participants (N = 155) and rank them. At the second stage, we ran an EEG experiment (N = 30). The sample was divided into 2 groups (N = 15 for each one): Group1 (participants with high IQ), Group2 (participants with low IQ). Both groups were presented with verbal antilogies (e.g. *straight turn*), normal (*turn lef*) and meaningless (*turn dry*) phrases while ERP recording. It was shown that ERP-markers of verbal antilogies comprehension differ in participants with high and low IQ. Individuals with high IQ had greater activation in the N400 time window after the presentation of antilogies and meaningless phrases if compared to normal phrases presentation. Participants with low IQ had greater activation in the N400 time window after the presentation of meaningless phrases but lower one after the presentation of antilogies and normal phrases. In participants with high IQ, the activation in the P600 component was higher after the presentation of antilogies and normal phrases rather than that after the presentation of meaningless phrases. Individuals with low IQ had no significant differences in activation in the P600 time window when presented with different types of phrases. This indicates that people with high IQ tend to process verbal antilogies more efficiently than people with low IQ.

Keywords: verbal comprehension, verbal antilogies, ERP, N400, P600, IQ level

Mental simulation of behaviour related to vision, hearing, skin sensations, taste and olfaction

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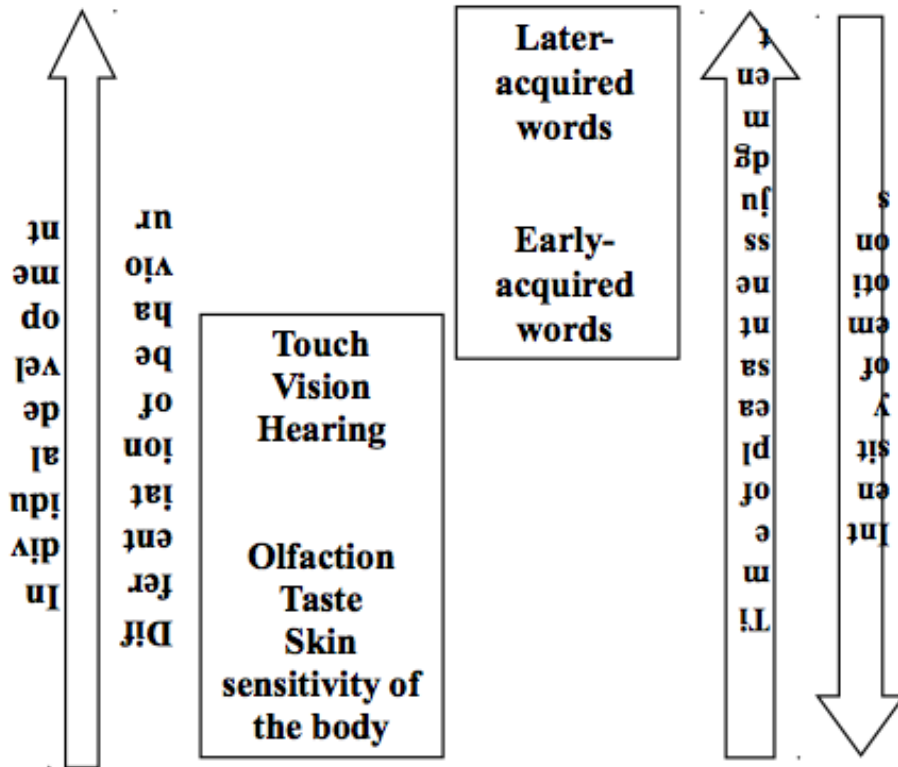[2]*National Research University Higher School of Economics, Moscow, Russian*

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An embodied approach to cognition implies that language is closely related to sensorimotor behavior. System-evolutional approach (Anokhin, 1973; Shvyrkov, 1990) suggests that the relationship between language and sensorimotor behavior can be accounted for by the nature of functional systems formed during learning effective organism-environment interactions, including verbal interactions. Such functional systems constitute networks of neurons along with other elements of the body. Functional systems are reactivated when individuals behave in the environment, imagine (simulate) or observe such behaviour, describe it or read about it. An important step in the study of the embodied nature of language is the investigation of peculiarities of semantic categories related to different sensorimotor activity (Hoffman, Ralph, 2013; Lynott, Connell, 2009). It was shown that in mammalian embryogenesis, skin sensitivity, and probably taste and olfaction start to develop earlier than hearing and vision (Gottlieb, 1971; Lickliter, Bahrick, 2000). In accordance with the united concept of consciousness and emotion (Alexandrov, 1999; Alexandrov, Sams, 2005) we assumed that the earlier behaviour is formed, the faster individuals can reactivate (simulate) this behaviour and the higher the intensity of their emotions generated by mental simulation of such behaviour. We also hypothesized the similar pattern for words that peoples learn at early and later stages of their development.

In our study participants were asked to imagine the behaviour described in the question "What do you feel when you see an object" (hear a sound, sense a smell, sense a taste or touch an object) that was completed with different adjectives described corresponding sensations (e.g., "big", "loud", "sweet", "silken", and so on). The participants had to assess the un/pleasantness of generated emotions by pressing one of the seven response keys on the keyboard, with very pleasant at +3, very unpleasant at -3 and neutral at 0 (for details, see Kolbeneva M.G., Alexandrov Yu.I. (2016) PLoS ONE 11(7): e0159036.)

Results (see fig.; arrows indicate an increase in characteristics) are in line with our hypothesis: behaviour predominantly related to vision, hearing and all skin sensations took more time for the simulation and pleasantness judgment than that predominantly related to olfaction and taste. Mental simulation of behaviour predominantly related to vision, hearing and touch generated less intense emotions than mental simulation of behaviour predominantly related to olfaction, taste and skin sensitivity of the body. We also found that sense-related behaviour described by early-acquired adjectives took less time for the pleasantness judgment and generated more intense and more positive emotions than that described by later-acquired adjectives. All in all these findings support the hypothesis that early-formed behaviours are less differentiated than later-formed ones. These differences between behaviors and characteristics of corresponding words are connected to each other.

Keywords: embodiment, sensations, differentiation, AoA, Russian sense-related adjectives

Individual development → **Differentiation of behaviour**

Touch
Vision
Hearing

Olfaction
Taste
Skin
sensitivity of
the body

Later-acquired words

Early-acquired words

Time of pleasantness judgement

Intensity of emotions

Things you never touch have colour: An experimental test of the metaphor Light is Good and Dark is Bad

Sofia Kostareva[1], Armina Janyan[2]

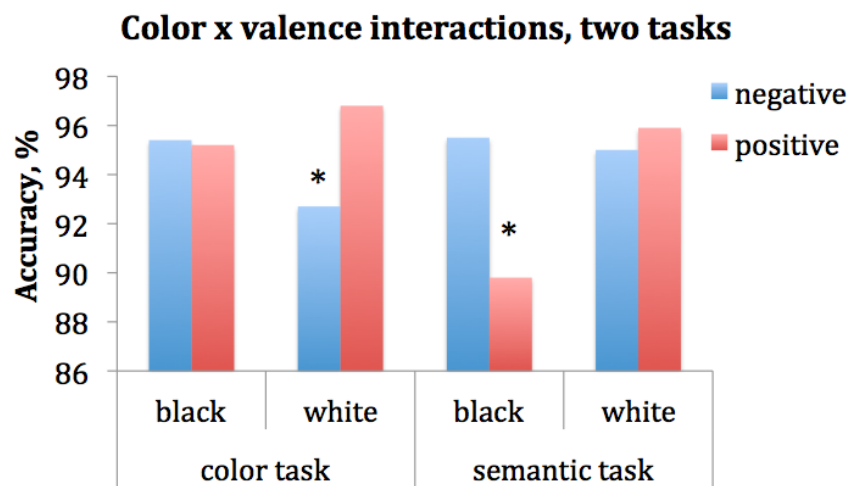[1]*Tomsk State University, Tomsk, Russia*

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One of the strongest claims of grounded cognition is that the structure of our mental representation of abstract thoughts and concepts is based on our perceptual and motor experience. Two experiments were conducted to test whether simple colour perception would modify processing of positive and negative meanings of adjectives. The words were presented in white and black colours on a grey background. In Experiment 1, participants had to categorize colours (black vs. white) while ignoring the word meaning. In Experiment 2, participants had to categorize meaning of the adjectives (positive vs. negative), ignoring the colours. The results showed that in Experiment 1, participants were more accurate in categorizing white colour if it was the ink of a positive word, and less accurate if the word was negative. Categorizing black colour was not sensitive to the word meaning. However, in Experiment 2 black colour exerted its role: participants were less accurate in categorizing positive adjectives than negative ones if the words were printed in black. White print colour here was not important. Overall, first, the results suggested that the structure of abstract domains of *good* and *bad* depends on our perceptual experience and second, that the facet of this manifestation may depend on the task focus and task demands. Our next experiments are sought to explore these possibilities.

Keywords: conceptual metaphor, perceptual experience, embodiment

The role of emotional words in learning statistically dense and sparse categories[6]

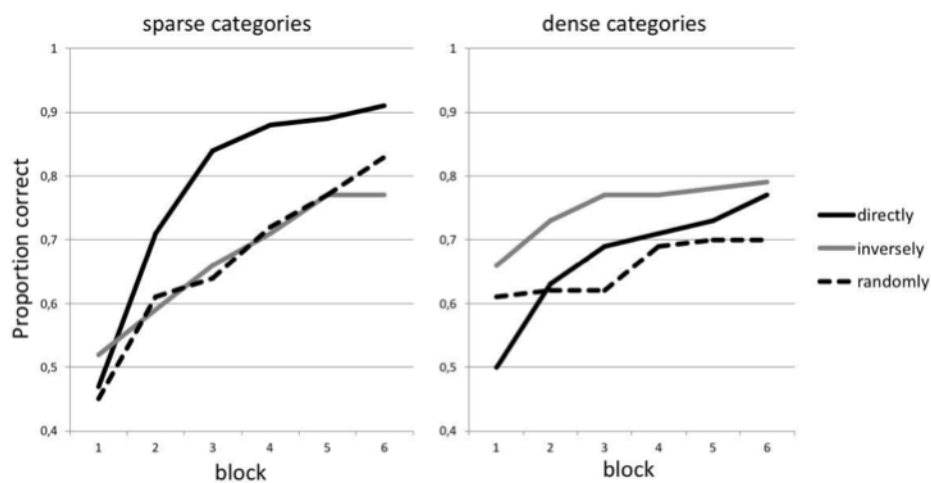Alexey Kotov[1], Tatyana Kotova[2], Svetlana Pokidysheva[3]

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The goal of the present study was to assess the influence of the emotional words on the learning different types of categories. Subjects (N=140) were given classic category formation tasks with feedback. We used two types of categories - statistically dense and statistically sparse. After feedback participants were given emotional words (database ENRuN, Emotional Norms for Russian Nouns; Lyusin, Sysoeva, 2015, 2016) only from two semantic groups, happiness or sadness. Those words were related to feedback directly (e.g., happy word after positive feedback), or inversely (e.g., sad word after positive feedback), or randomly. We found (Fig.1) that in the case of dense categories formation, the relation between feedback and an emotional word had no impact on the learning (p>0.1). In the case of sparse categories formation, performance was much better in direct relation condition than in the inverse or random relation conditions (F(1;38) = 6.08, p=0.018).

The results of the experiment will be discussed in the framework of the COVIS model of multiple systems of categorization (Ashby et al., 1998).

Keywords: emotional words, category learning, feedback, memory, COVIS model

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Gender Differences in Comprehension and Logical Memory Functioning in Patients with RMTS

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Background: Temporal lobe epilepsy is linked with language related cognitive impairment in males and females. The present study is focused on the difference in comprehension and logical memory functions between male and female MTS subjects.

Objective: To assess the gender differences in comprehension and logical memory functions, to understand the outline of cognitive deficits, and to understand the depression level of Mesial Temporal Sclerosis (MTS) subjects.

Method: A sample of 41 Mesial Temporal Sclerosis (MTS) adults was recruited during 2012-2016. The sample of 41 MTS subjects consists of 23 males (mean age 35.13 ± 15.22) and 18 females (28.24 ± 9.12 years). These subjects were referred to Bangalore Neuro Centre from the community. Standardized neuropsychological tests were used in the domains of Verbal Working Memory, Comprehension (Token Test) and Logical Memory (Passage Test) for the literate groups. Scores were compared with age, education and gender specific norms, wherein scores falling below the 15th percentile of the normative data were treated as deficits. Mean, Standard Deviation and 1 way ANOVA were used to analyze the data.

Results: Male and female MTS groups differ significantly only in passage memory - immediate recall ($p < 0.02$) and delayed recall ($p < 0.01$). With respect to mean scores, female MTS groups got higher mean scores than their male counterparts. Based on Indian normative data, percentage analysis shows that cognitive impairment amongst males in Passage memory immediate recall is 82%, in delayed recall it is 91%, in comprehension it is 31%, in verbal working memory it is 47%, more than their female counterparts. The depression score was not statistically significant between male and female subjects.

Conclusion: The present study shows that female MTS subjects' performance on language based cognitive functions is better than their male counterparts.

Keywords: Mesial temporal sclerosis, gender differences, cognitive impairment, comprehension, logical memory

Neuropsychological Variables	Groups Compared	N	Mean	Standard Deviation	F	Level of Significance
Logical memory immediate recall	Males	23	4.00	2.06	5.37	**0.02**
	Females	18	5.88	2.61	5.37	**0.02**
Logical memory delayed recall	Males	23	5.87	3.50	1.86	**0.01**
	Females	18	8.95	3.21	1.86	**0.01**
Verbal working memory – 1 back hits	Males	23	8.26	3.02	0.43	0.51
	Females	18	7.47	4.19	0.43	0.51
Verbal working memory – 2 back hits	Males	23	5.71	2.32	2.10	0.15
	Females	18	4.45	2.89	2.10	0.15
Comprehension – token test	Males	23	25.86	3.89	0.09	0.76
	Females	18	26.43	7.35	0.09	0.76

Table illustrates one-way ANOVA comparison of male and female groups on neuropsychological tests.

Gaze control in the visual world paradigm

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Visual world studies demonstrate that auditory linguistic cues trigger saccades to the referent (Huettig et al., 2011; Knoeferle and Guerra, 2016). Interestingly, eye movement experiments on maintained fixation show that participants can effectively suppress their saccades (Kowler, 2011). To what extent are we able to control our saccades given linguistic cues? We investigated the influence of referential relationships (nouns and pronouns) on eye movements in two visual world experiments. In the first, participants were implicitly allowed free inspection of the visual scene while listening to a story. In the second, they were asked to not look at the picture that the narrator was speaking about. 40 Russian speakers took part in each experiment that consisted of the same 32 stories and corresponding visual displays.
Participants of the second experiment successfully suppressed their saccades to referent pictures: 14% of fixations on pictures referred to with nouns and 7% — with pronouns, compared to 61% and 52% in the first experiment. The probability of looking at the referent picture was greater in the first experiment (*Est.* =-2.55, *SE*=0.17, *p*=0.001). Additionally, in the second experiment the probability of fixating an object referred to with a pronoun did not decrease as much as the probability of fixating an object referred to with a noun (*Est.*=-0.89, *SE*=0.28, *p*=0.01): the participants were less able to control their eye movements when hearing a pronoun. It seems that processing indirect nominations is more effortful, so that people are searching for more information and use visual context to determine a referent.

Keywords: attention, visual word paradigm, cognitive control, eye movement control

Primary and Complex Conceptual Metaphors Comprehension and Possible Embodiment EEG markers

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The aim of the study was to detect the differences in EEG power spectra and coherence during "primary" and "complex" (J. Grady & R. Gibbs terms) conceptual metaphors comprehension. This could show the differences in their mental processing on psychophysiological level and also detect the markers of their abstractness/embodiment.

Stimuli and procedure design were developed following C. Lachaud (Lachaud, 2013). 2x2 design was used. "Complexity" and "metaphoricity" were varied: "the prices have risen" (primary metaphor) vs "his phone is dead" (complex metaphor); "he has risen from the chair" (one of non-metaphorical controls). The presented sentence could contain or not a metaphor (which in its turn could be primary or complex). Right after subjects were to choose between the two test words a correct one expressing the meaning of a presented sentence.

34 students (29 women) participated, mean age 21 years. 19 monopolar leads EEG (10–20) were used.

The results show that the power spectra decrease during the process of primary metaphors' comprehension. We suggest that this task involves more brain resources and is related to the transition from a different mode of information processing: after reading a primary metaphor based on unseparated situated/embodied phrase subjects were to read two more abstract test words\phrases and make a decision between two options.

Complex metaphors comprehension is accompanied with the larger amount of coherence, in particular — in the increase of interhemispheric connections. Primary metaphors comprehension involves frontal lobes coherence increase, which might signify premotor cortex activation responsible for the literal meaning enactment.

Keywords: conceptual metaphor, primary and complex metaphors, spectra of EEG, EEG coherence.

Simulation and Perspective in Literary Translating: Experientiality in Intersubjectivity[7]

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Taking a sociocognitive perspective on language as a situated embodied practice, Translation Studies has shifted its focus to the "situated translator" (Halverson 2014) in the "extended translation process" (Risku & Windhager 2013) and cognitive patterns driving their behavior within working and sociocultural environment. However, the relational domain of text-mediated coupling of the translator's "living/lived body" (Thompson 2005; Kyselo 2014) with the *non- existent* (fictional) world remains ignored while in literary translating that world rather than the source text by itself seems to be what the translator is to make sense of and hence has first to imaginatively enact (simulate) (e.g. Caracciolo 2014; Zwaan 2003) and get situated in; otherwise it is impossible to pre-coordinate an *adequate* holistic configuration thereof for the target text reader. My contribution will focus on the translator's phenomenal experience quasi-perceptually lived in such simulation (and verbalized in the target text) from a certain bodily and evaluative perspective and on the role language- and culture-specific cognitive models play therein. Since normally the translator is supposed to perceive source and target texts as quite equivalent (with possible *intended* limitations) signifiers for their mental image of the fictional world (signified), the results of my study, based on analysis of a corpus of translations from English into Russian and data from British and Russian National Corpora, are interpreted as providing further evidence for simulative and perspectival (concerning both spatiotemporal and sociocultural dimensions) nature of text comprehension and text generation processes and for a dialectical (interactionist) relationship of mind, language and culture.

Keywords: literary translating; simulation semantics; narrative experientiality; intersubjectivity; perspectivation.

Language background and the effects of time delay on visual-spatial mental-attentional capacity

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Research shows that performance on working memory tasks is affected by time delays. According to the Theory of Constructive Operators, working memory performance is driven by individual differences in mental-attentional capacity. To date, no study has examined the relation between mental-attentional capacity and time delay. Our main goal is to examine the effects of time delay across six levels of parametric increases in difficulty. We will also evaluate language background and ability to inhibit distractors. Participants (n = 31, 20-30 years, ~50% female) completed the Colour Matching Tasks with three time delays (500ms, 1000ms, 3500ms) in addition to the Figural Intersection Task, Stroop, and Language and Social Background Questionnaire. We expected that results will show that time delays differentially affect performance based on difficulty. Specifically, longer delays were expected to lead to improved performance in difficult tasks and hindered performance in easy tasks. Repeated measures ANOVAs are used to examine time delays across tasks, and correlational analyses to examine relations among all tasks and language background. Results from this study will practically and theoretically contribute to understanding of appropriate use of the delay and knowledge on the effect language background can have on performance.

Keywords: working memory, mental-attentional capacity, language background, visual-spatial, time delay
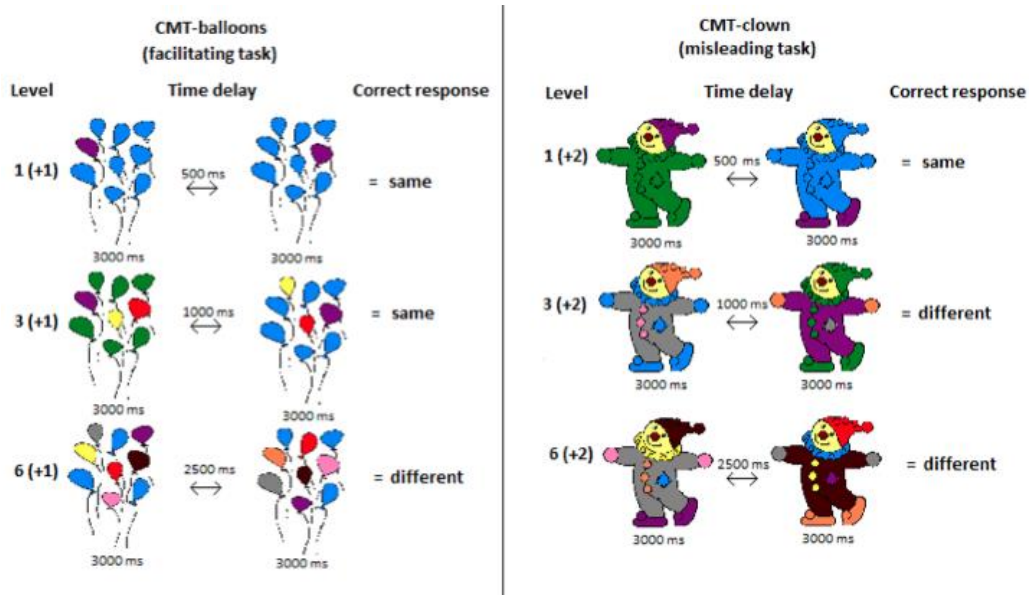
Figure 1. Example of the stimuli for Colour Matching task. Level corresponds to difficulty level which is indexed by number of relevant colours +1 for balloons and +2 for the clowns.

The tour guide manipulates the addressee's attention: Evidence from the eye tracker study

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Introduction: The nature of excursion communication was studied extensively (Bahvalova 2010; Demidov, 2008) during the last 20 years, but the interplay between participants during the tour has never been studied experimentally. During the tour, the guide uses special markers that are meant to manipulate the visitor's attention and thereafter facilitate the apprehension of information (e.g. "look there"). We hypothesized that the time needed for addressee to fix on the object of interest (RT) varies as a function of the marker category.

Methods: 15 students (Age, M = 18.1, SD = 1.1; 16 females) from Tomsk State University were recruited for participation in the experiment. Participants were invited to visit a museum and listen to an excursion with the head-mounted eye tracker on. Categories were specified according to the presence/absence of a specific component. RT counting started from the guide's gesture.

Results: The speech markers of a guide showed distinct semantic categories: locative, visual-locative, nominative, and indicatory-locative. Welch ANOVA showed that there was a significant effect of the marker category on RT [$F(3, 192) = 7.69$, $p < .001$]. Post hoc comparisons using the Games-Howell test indicated that the mean score for nominative category (M = 1183, SD = 608) was significantly bigger than locative and indicatory-locative ones (M=812, SD=325; M=804, SD=468 respectively).

Discussion: The data provides yet another evidence of the tour guide manipulating the oculomotor activity of the addressee. Moreover, the RT was associated with the type of the marker, with the biggest RT for nominative one.

Keywords: eye movements, excursion, visual attention, reaction time, field experiment.

Reassessing our cognitive models in language processing

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In contradistinction to a central tenet of modern linguistics, there is clear evidence in their 'hidden' internal architecture that languages are organized around meaning. Indeed, languages can be conceptualized as highly structured, three- dimensional meaning networks, which share many of the same properties as the number system, including discrete infinity, the use of irreducible atomic elements, place value notation and the same point of beginning. Although the inner architecture of the meaning system instantiated in any language lies beyond our conscious awareness, my research suggests that it can be inferred by understanding the rules that govern how meaning is created and distributed in the network. Using English as an exemplar, I focus in this paper on how the smallest chunks of meaning combine to make words by following a simple set of self- organizing rules analogous to the syntactic rules that govern how words combine to build meaningful sentences. When viewed through this lens, once- hidden design features of languages are revealed. I will explore some of these design features, including the architectural design feature of languages that creates meaning itself; the architecture of words in thought; the significance of place value (*i.e.*, the location of a unit of meaning in a word) in determining meaning; and how identification of fields of meaning are key to understanding how languages emerged.
If proven, such a meaning- centric interpretation of languages would require a fundamental reassessment of our understanding of the basic building blocks of languages and a corresponding shift in the architecture of our cognitive models.

Keywords: neurolinguistics, meaning in languages, network theory, cognitive models, architecture of words.

The Tentative Study on the Stability of the Sound's Vertical Spatial Metaphor evoked by sound words

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At present, the research about the physical sound shows that sound has metaphorical representation. There are two main forms of sound: physical sound and conceptual sound. Does conceptual sound has the metaphorical representation, as physical sound?

Three experiments(two different paradigms) were used to investigate if the sound words exist vertical spatial metaphor. Experiment 1 use the same paradigm of Sibylla Wolter (2015), with the keyboard erected, participants were asked to judge (yes/no) whether the sentences were meaningful by means of up/down (Experiments 1 and 2) key press responses. In experiment 2, we use the priming paradigm with horizontal keyboard. In experiment 2a, the sound words are passively observed, participants were asked to judge whether the shape present was square or circle. In experiment 2b, participants will judge the pitch of the sound words first, then judge as experiment 2a. Metaphorical effects only observed in the experiment 2b which the semantic of the words were deeply processed. That means the metaphor of the sound words is weak or unstable.

The degree of imagery and the semantic access of the sound words may explain. Afterword questionnaire brought out that the sound words commonly consist a variety of imagery, however, sound doesn't occur first. It means that the sound words' vertical metaphoric can only occur in the case of deep-level semantic processing.

Keywords: sound words; Vertical Spatial Metaphor; the stability of metaphor; imagery.

Experiment 3: Mean RT(ms)、ACC(%) in different conditions

Pitch	Sound words(low pitch)		Sound words(High pitch)	
Picture's location	Up	Down	Up	Down
RT	551(151)	579(127)	460(127)	559(127)
ACC	0.93(0.08)	0.92(0.07)	0.93(0.39)	0.93(0.06)

Naïve physics in language ---A case study of light-related fictive motion

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This study argues that light-related fictive motion expressions are motivated by our naive understanding of light and its associated entities. Although common in daily life, light-related entities, such as light, shadow, and vision, are non-palpable and we lack concrete and palpable interactions with them. This leads to our naïve understanding of them. In language, scenes associated with light-related concepts are frequently represented as involving fictive motion.

Fictive motion is represented in sentences that describe static scenes with dynamic linguistic forms. Light-related fictive motion include radiation paths (sentences that describe static scenes of light in terms of the movement of light), shadow paths (expressions that depict static scenes of shadow as the movement of shadow), and visually sensory paths (sentences that represent visual perception in terms of some movement between the eyes and the perceived object).

The data used for this study are 627 Chinese light-related fictive motion expressions collected exhaustively from a set of written texts. They are analyzed in terms of the cognitive models involved. Results show that the construal of light in fictive motion expressions echoes naïve theories of light. An example is that vision in fictive motion is represented as either the movement from the eyes to the perceived object or the other way around, and these two representations are widely found in kid's understanding of vision. The naïve understanding of light-related concepts has a strong influence on language, though it may have been merged with or even replaced by the scientific one.

Keywords: light, fictive motion, naïve physics, cognitive model, Chinese

Embodied metamemory: JOL´s and vertical space

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Close relationship between physical space and internal knowledge representations has received ample support in the literature. For example, location of visually perceived information in vertical space has been shown to affect different numerical judgments. In addition, physical dimensions, such as weight or font size, were shown to affect judgments of learning (JOLs, an estimation of the likelihood that an item will be remembered later, or its perceived memorability). In two experiments we tested the hypothesis that differences in positioning words in vertical space may affect their perceived memorability, i.e., JOLs. In both Experiments, the words were presented in lower or in upper screen locations. In Experiment 1, JOLs were collected in the centre of the screen following word presentation. In Experiment 2, JOLs were collected at the point of word presentation and in the same location. Finally, participants completed a free recall test. JOLs were compared between different vertically displaced presentation locations. In general, Bayesian analyses showed evidence in support for the null effect of vertical location on JOLs. We interpret our results as indicating that the effects of physical dimensions on JOLs are mediated by subjective importance, information that vertical location alone fails to convey.

Keywords: embodied cognition, metamemory, judgments of learning, vertical location, Bayesian analyses

Pacifier overuse and processing of abstract, concrete and emotional concepts

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According to recent theories, while all concepts are grounded in sensorimotor experience, abstract concepts activate linguistic and social information more than concrete ones. Evidence has shown that abstract concepts processing occurs through a simulation involving the mouth. Such activation of the mouth can be due either to the re-explanation of the word thanks to inner talk or to the retrieval of the linguistic acquisition experience.

The aim of this study is to explore if the extensive use of an oral device since infancy, by inhibiting the simulation, influences learning and consolidation in memory of abstract and emotional concepts compared to concrete concepts. We predicted that children who overused the pacifier (for more than three years and during social interactions) would be less competent in processing abstract and emotional concepts than children who did not.

First grade children, with a history of different frequency of pacifier use, provided oral definitions of the meaning of abstract, emotional and concrete words.

Results showed that concrete, abstract and emotional concepts elicited a clearly distinct pattern of conceptual relations. Moreover, late users of pacifier distinguished less clearly between concrete and emotional concepts and between concrete and abstract concepts, producing more exemplifications and functional relations than early users who instead used more free associations, especially with abstract concepts.

Overall results suggest that the influence of pacifier is a long term one, and that it affects especially abstract and emotional concepts: children who overused the pacifier seemed to ground and exemplify concepts more than children who didn't.

Keywords: embodied cognition, grounded cognition, abstract concepts, language acquisition, language processing.

The Force of Numbers: Conceptual Processing of Numbers Activates the Motor System

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In previous studies, spontaneous motor activity of the hands during conceptual processing of action-related words was found with a grip force sensor (Aravena et al., 2012; Nazir et al., 2015). Other studies showed a role of spatial associations in number processing (Winter et al., 2015 for review) that is mediated by finger counting (Fischer, 2008) and grasping behavior (Andres et al., 2004).

The present study combines these lines of research by recording the applied motor force with which participants held grip force sensors in their left and right hand during number processing. Single numbers were presented on the screen and participants detected repetitions. We report data from right-starters (i.e., people who start counting on their right hand, N=13) and left- starters (N=13) showing a modulation of grip force by number magnitude and counting preference in the time window from 400 to 600 ms after number presentation (Figure 1). Note, the task required no manual responses, suggesting automatic and unconscious modulations. The results therefore contribute to our understanding of single number processing in real-time and will be discussed in terms of the theory of embodied cognition (Fischer, 2012) and in comparison with data from EEG studies of numerical cognition.

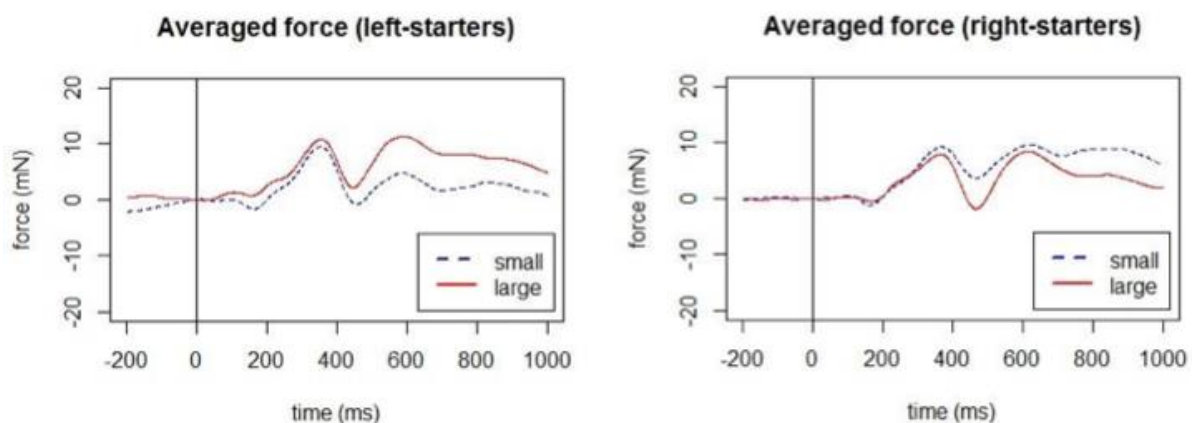**Keywords:** grip force sensor, number processing, SNARC, finger counting, motor system

Figure 1. Averaged force from both hands for the subsamples of left-starters (left panel) and right- starters (right panel). Solid line represents numbers of magnitude 6-9, dashed line numbers 1-4.

Gesticulation reflects speaker's cognitive processes during a story retelling[8]

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Spontaneous gestures accompanying speech explicate some cognitive processes underlying speech production. Embodied metaphors used by a speaker allow us to follow the steps s/he passes creating the narration.

We studied retellings of the famous "Pear Story Film" (Chafe 1980) recorded for the multimodal "Russian Pears Chats and Stories Corpus" (multidiscourse.ru) and found patterns used by most speakers. The beginning of narration is usually marked by a PUOH gesture (Müller 2004) as the speaker presents the story as a whole. Protagonists appearing for the first time are also accompanied by these gestures. After the first presentation the speaker in next clauses transfers with gestures relevant information about the protagonist (characteristics and actions). The process can be compared with topicalization in syntax.

Also gestures distinguish "background – main line of the story" with similar form of hands facing a listener. These gestures accompany clauses describing the landscape and other background information. A transfer to a new subject is often marked by a beat or a similar gesture. A concurrent referent or two referents in a scene can be distinguished by deictics, sometimes combined with a PUOH gestures.

Turn-taking and lexical choice also become apparent through relevant gestures.

Keywords: gesticulation, metaphors, multimodal corpora, narration

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The Influence of Referential Gaze on Spoken Language Comprehension: Agent vs. Human Gaze

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Interlocutor's gaze behaviour is a fundamental aspect of face-to-face communication, and facilitates spoken language comprehension. Research suggests that people can also use a virtual agent's gaze in interactions (e.g. [3], [4], [2]). Our study addressed effects of human speaker gaze vs. virtual listener gaze on reaction times, accuracy and eye movements. We manipulated: (1) whether the human speaker, uttering the sentence, was visible, (2) whether the agent listener was present (*Figure 1*) and (3) whether the template following each video matched the scene. Participants saw videos in which a static scene depicting three characters was visible on a screen. Eye movements were recorded as participants listened to German SVO sentences describing an interaction between two of the three characters, e.g. *Der Kellner beglückwünscht den Millionär* ('The waiter congratulates the millionaire'; materials from: [1]). After each trial a template schematically depicting three characters and the interaction appeared on screen. Participants verified a match between sentence and template. Participants solved the matching task very well across all conditions. They responded faster to matches than mismatches between sentence and template. Additionally, participants were slower when the agent was present. Eye movement results suggest that at the NP2 region participants tended to look at the NP2 referent to a greater extent when the speaker was present compared to the other conditions. These results substantiate previous findings by Kreysa & Knoeferle (2011). When both gaze cues are available, only human speaker (but not agent listener) gaze guides attention during spoken language comprehension.

Keywords: spoken language comprehension, human speaker gaze, virtual agent, listener gaze, eye tracking

Figure 1: Overview of the four experimental conditions for the video trials.

How visual are (novel) verbs in constructional simulation?

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There is a growing body of evidence that language evokes and activates visual simulations (Barsalou 1999; Stanfield & Zwaan 2001; Zwaan et al. 2002; Bergen et al. 2007; cf. Johansson 2013). Accordingly, Swedish motion expressions, such as (1), should evoke a simulation of an entity moving from one point to another.

(1) Vi sprang iväg till affären ('We ran off to the store')

The example instantiates a syntactic construction, that includes the directional adverb *iväg* 'off' and the goal-denoting preposition *till* 'to'. The verb *springa* 'run' evokes a manner of motion co-event (cf. Talmy 2000). The question, discussed in this paper, is to what extent the assumed visual simulation of a motion scene is connected to the particular verb and to what extent it is connected to the pattern as whole, since syntactic constructions contribute to meaning (cf. Goldberg 1995; Kaschak & Glenberg 2000). A special focus concerns productive uses of the construction, with verbs such as *skratta* 'laugh' or *hjorta* 'to deer'. *Skratta*, in this case, is interpreted as some concomitance co-event, while *hjorta* is used to denote the manner of motion.

I will present an experimental sentence-picture study where participants were asked to decide as fast as possible whether a picture (e.g. 'someone laughing', 'a deer', 'someone moving') was mentioned in a preceding sentence. Preliminary results indicate that in manner cases, the verbs are visually simulated approximately to the same extent as the motion construction, while in the concomitance cases, the construction is less prominent.

Keywords: visual simulation, construction grammar, motion verbs, Swedish

Not all reading is alike: task effects on MEG evoked response to written word in silent reading and verb generation

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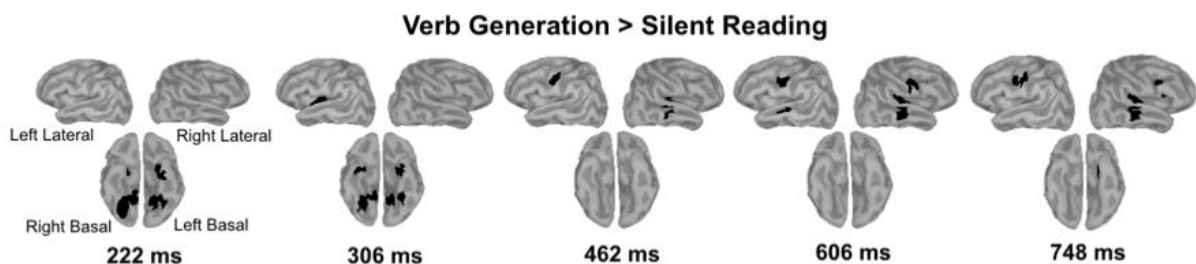
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Transforming the sensory input to appropriate motor response is a fundamental aspect of language ability. Previous studies show that the task requiring an immediate motor response modifies processing of a visually presented word compared to its silent reading. Here we aimed to examine whether the task that uses the presented word not as the target but a cue to produce another word still modifies its recognition process. Using MEG and magnetic source imaging, we compared spatio-temporal pattern of brain response evoked by a noun cue when it was read silently either without additional task (SR) or with a requirement to generate an associated verb (VG). We found that the task demands penetrated into early (200-300 ms) and late (450-800 ms) stages of written word processing by enhancing brain response under VG versus SR condition. The cortical sources of the early differential response were localized to inferior occipito-temporal regions and anterior temporal cortex, suggesting more elaborated visual form processing and lexico-semantic analysis under VG task. The highly reliable late effect was observed in the associative auditory areas in middle and superior temporal gyri and motor representation of articulators bilaterally and could be associated with enhanced sensorimotor transformations. Thus, our results show that even the remote goal interacts with written word recognition and suggest complex lateralization patterns for enhanced linguistic processing.

Keywords: visual word recognition, top-down modulations, sensorimotor transformation, speech lateralization, magnetoencephalography (MEG)

Verb Generation > Silent Reading

Successful retrieval of emotional stimuli reduces the retrieval success of neutral stimuli

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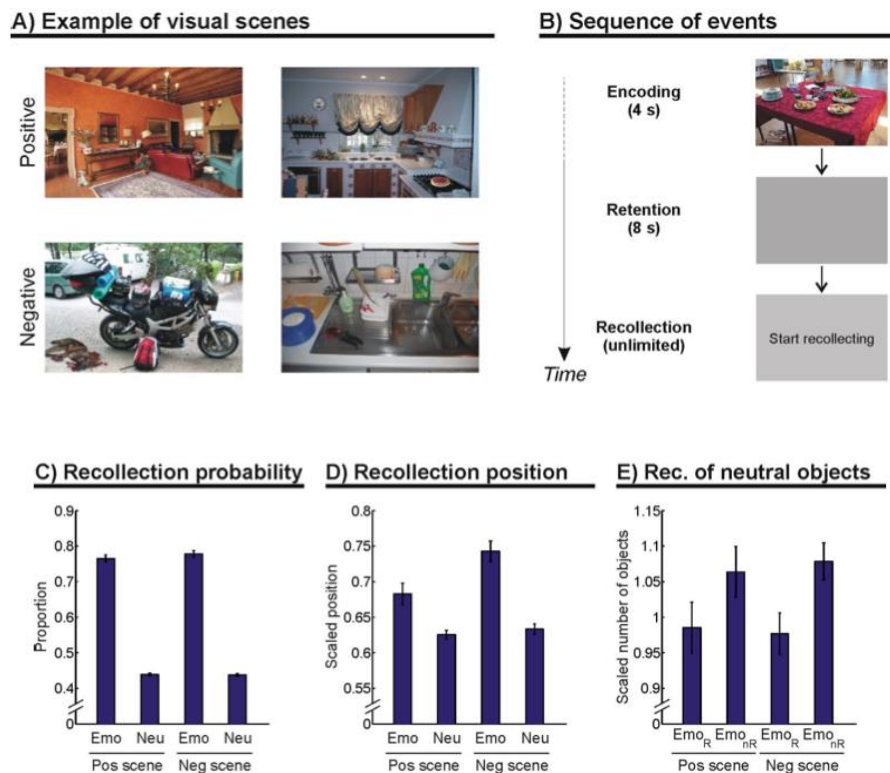*[1]National Research University Higher School of Economics, Moscow, Russia*

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Emotional events are thought to have privileged access to attention and memory, consuming resources needed to encode competing emotionally neutral stimuli. However, it is not clear whether this detrimental effect is automatic or depends on the successful storage of the specific emotional object. Here, we presented everyday scenes including an emotional object among other neutral objects for a subsequent free-recollection task. Results showed that emotional objects − irrespective of their perceptual saliency − were recollected more often than neutral objects, and affected the organizational strategy of output retrieval. The successful recollection of the emotional object caused a greater reduction of memory contents, evidenced by a decreased amount of neutral information recollected. This indicates that the efficiency of the specific emotional stimulus to attract and consume available attentional resources plays a crucial role during the encoding of competing information, with a subsequent bias in the recollection of neutral representations.

Keywords: emotion, salience, working memory, capacity, free recollection.

Spatial congruency effects, just not for words: Looking into Estes, Verges, Barsalou (2008)

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According to the embodied view of cognition, perception of words that carry sensory-motor features in their semantics activates sensory-motor simulations, which, in turn, interact with spatial responses to produce grounded congruency effects. In this view, it's expected that object words associated with a certain spatial representation (e.g. bird) elicit associations for their typical location (in this case, "up" for bird). Estes, Verges and Barsalou (2008) reported that centrally presented words denoting objects usually appearing in the upper/lower portion of the visual field influence the identification of stimuli appearing up/down on the display: stimuli that are spatially congruent with the typical location of the word elicit faster responses. This result has important implications for theories of language processing. In a series of 9 experiments, run in three different laboratories, we tried to replicate this pattern of results, but without success. We found an effect of the instructions given to the participants, and a spatial compatibility effect so that stimuli appearing up/down on the display get faster responses if the response key is placed in the upper/lower than in the lower portion of the keyboard, respectively. Critically this last effect was independent of the word stimuli. The results challenge the conclusion drawn in Estes et al. according to which object words orient attention to the object's typical location. We contend that the activation depends on task conditions, and therefore the location cue congruency effect needs to be taken with caution.

Exp.	N Words	Word duration	Delay (ms)	Targets	Resp keys	N Part	Lang	Fillers	Effect	Net effect (msec)	t	BF
Estes et al. Exp 3	60	50	50	X, O	X, O	30	English	Yes (60)	LCC	32		
1	24	150	150, 450, 900	□, O	G, H*	39	Italian	No	LCC	-.84	.46	.05
									FI	-20.04	***8.91	>10,000
2	24	150	150, 450, 900	□, O	G, H*	41	Italian	Yes (18)	LCC	2.54	-1.06	.10
									FI	-21.82	***9.60	>10,000
3	24	150	150, 450, 900	□, O	G, H*	20	Italian	Yes (18)	LCC	-3.38	1.29	.20
									FI	-23.38	***9.78	>10,000
4	64	100	100	C, M	C, M^	16	Italian	No	LCC	1.04	-.09	.16
									FI	-22.93	7.36	>10,000
5	56	50	50	X, O	X, O	20	Italian	No	LCC	3.50	-.86	.33
									FI	-35.45	***8.40	>10,000
									Simon	-23.20	***5.61	>10,000
6	56	50	50	X, O	C, M^	24	Italian	Yes (56)	LCC	2.60	-.42	.23
									FI	-38.70	***9.18	>10,000
7	56	50	50	X, O	C, M^	25	Italian	Yes (56)	LCC	7.78	*-2.04	1.67
									FI	-37.16	***8.82	>10,000
8	56	50	50	X, O	C, M^	60	Italian	Yes (56)	LCC	-2.85	.74	.24
									FI	-47.59	***8.85	>10,000
9	60	50	50	X, O	X, O	40	English	Yes (60)	LCC	-2.26	.47	0.17
									FI	-37.25	***9.12	>10,000
									Simon	-20.97	***4.98	>10,000
All studies									LCC	0.36	-.23	.01
									FI	-27.65	***13.2	>10,000

Table 1. The left part of the table reports a summary of the principal methodological aspects of the Experiments reported in the present paper and Experiment 3 by Estes et al., 2008. The right part of the Table reports the results of our experiments.
Table Legend: N words=number of experimental words; Delay=time between the offset of the cue word and the onset of the target; Resp keys=keys used for the response; N part=number of participants; Lang=language used for word presentation; Fillers=presence of filler trials intermixed with experimental trials, in parenthesis it is reported the number of filler trials; Effect=LCC refers to location cue congruency effect, FI refers to the feature integration effect; BF=Bayes Factor

The role of attention in sentence production: Beyond the visual modality

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In a fully developed production system, perception provides an input of information about the event, attention foregrounds relevant/important information for the conceptual analysis, and subsequent language production mechanisms collaborate to generate speech (Levelt, 1989). A part of this complex process is the necessity to select between simultaneously available syntactic alternatives. For example, English language provides several options that can describe the same visual event, e.g., an officer chasing a burglar. These minimally include (1) *The officer is chasing the burglar* and (2) *The burglar is (being) chased by the officer.* These active- and passive-voice alternatives differ in assigning object and subject roles to agent (officer) and patient (burglar). Existing evidence suggests that the system responsible for assigning the grammatical roles is sensitive to the distribution of the speaker's attention within the described scene (Tomlin & Myachykov, 2015, *for a recent review*). Specifically, a speaker of English is more likely to choose a passive-voice frame when her attention is directed to the patient of the described event and she is more likely to use an active-voice frame when the agent is in her attentional focus (e.g., Myachykov, et al., 2012). While this and other studies indicate a regular interplay between attention and syntactic choice, they also exclusively used variants of the *visual cueing* paradigm (Posner, 1980). As a result, the reported link between attention and syntactic choice cannot be generalized beyond the visual modality. A more ecologically valid proposal needs to take into account a multi-modal nature of attention.

Here, we report results of a sentence production study, in which English native speakers described visually presented transitive events (e.g. kick, chase, push). In half of the trials the agent appeared on the left and in the other half – on the right. Speakers' attention to the referents was manipulated by means of a lateral cue. The cue was either *auditory* (beep played monaurally) or *motor* (participants were prompted to press a left or a right key depending on the color of the central fixation cross). Hence, the Cued Referent (Agent/Patient) was crossed with the Cue Type (Auditory/Motor). The proportion of the produced passive-voice sentences was the dependent variable. First, we replicated previous findings by registering a main effect of Cued Referent (more

passive-voice sentences in Patient-Cue condition: $X2(1) = 5.29$, p=.02). Second, there was a main effect of Cue Type (more passive-voice sentences in Motor-Cue condition:

$X2(1) = 6.56$, *p*=.01). Third, there was no interaction between the two factors suggesting that only one attentional at a time can impact syntactic choice. Overall our findings replicate previous findings using visual cueing paradigm and extend them to auditory and motor modalities.

Keywords: attention, language, syntactic choice, eye tracking, modality of attention

Contingence of declarative and procedural knowledge in Russian and Armenian languages

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We develop the idea of the contingency of differentiation/ integration of declarative knowledge (which are expressed in the taxonomic structure of concepts) and procedural knowledge. As a model for representation of the action we used the script for the verb "to prepare." In the Russian language the same verb is used to describe for cooking and for lessons preparation. In the Armenian language to describe the same action people use two different verbs (like English verbs "to prepare" and "cook"). We composed the two scripts (on concrete and basic levels) for description the cooking food and the preparing lessons.

When compiling the narratives was used scheme, proposed by J.-Fr.Richard (Richard, 1998) as a model of action's representation. This scheme includes the following components: goal setting, prerequisite, prior requirement, and sequence of actions, monitoring and evaluation of results. Linguistic components of narratives were chosen based on "primitives", fixed in the works of A. Wierzbicka The study involved Russian subjects and Armenian bilinguals. Each test group (20 people) worked with one of the variants of the script. The subjects were asked to listen to the one narrative, and then to retell it. We evaluated the accuracy of the retelling and the level of abstraction/concretization how of procedural and of declarative components of the script.

It was confirmed the hypothesis that the basic level of representation of the script corresponds to the wrinkled form of procedural knowledge, a concrete level of representation of the script corresponds to the basic form of procedural knowledge.

Keywords: procedural/declarative knowledge, concrete/ base levels of script, semantic universals, bilinguals

Psycholinguistic aspects of language and cognitive functioning in healthy elderly population

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It is well accepted that language and cognitive functioning differ in healthy elderly population. Relevant research report that cognitive abilities decay with age, while language is relatively intact. However, at the same time, more profound language processing analysis reveals differences among different aspects of language processing, as compared to younger population. This poster reports on research made within a larger study on language and cognitive processing in elderly population. The presented study is focused only on phonological and lexical aspects of language processing. In order to compare cognitive vs. language functioning four tests/tasks were administered. *Peabody Picture Vocabulary Test* was used to assess vocabulary, *Wisconsin Card Sorting Test for* assessing mental fluidity, two RT tasks for assessing motor and discrimination skills. Finally, *Lexical superiority task* with words of high frequency and phonotactic probability, pseudowords of high phonotactic probability and nonwords as strings of letters violating the phonotactic rules of Croatian was administered in order to show differential decay of language related skills and other cognitive functions. The participants were 50 elderly persons age 70 – 85, balanced for a number of men and women, for age and education. The results will be discussed primarily in terms of psycholinguistic analysis; however, the social impact on the quality of life of elderly population should not be neglected, as well.

Keywords: language processing, cognitive functioning, elderly population, phonotactics, lexical access

«Embodied grammar»: differences in the perception of marked and unmarked member of grammatical opposition[9]

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One of the ideas of the theory of embodied cognition (F. Varela, E. Thompson, E. Rosch) is that any conceptual knowledge is mediated by human perceptual channels. Therefore, any perceptual experience has a modal nature (L. Barsalou).

The report proves the idea that the process of perception - auditory or visual - interacts with the nature of the formal representation of the categorial semantics. At the same time, the marking manifests itself in the visual channel (formal indicator) and in the auditory channel (its pronunciation)

A formal indicator is present both in the visual channel (for example, the end of the word for the grammatical gender) and in the auditory (its pronunciation).

We examine the effect of marked / unmarked grammatical categories for their processing in the conditions of competition modalities. From the point of view of the linguistic structure, the marked element of the grammatical category is one that receives a more explicit expression, an unmarked element may not have any formal indicators at all. From the point of view of communication marked elements are less likely, therefore, their recognition and interpretation requires special formal parameters.

For example, for the category of gender the marked member of opposition is feminine (in Russian), because the words of feminine gender is ending with «–а/я» (knig-a (book), sten-a (wall) etc.) In the category of abstractedness a concrete word in marked.

Our hypothesis is that the formal index of the grammatical category (physical expression) will affect the interaction of the modalities in word/text processing.

The hypothesis was tested on the material of Russian and Bulgarian languages. In a series of experiments tested the difference in the perception of marked and unmarked words by the example of categories of abstractness and grammatical gender.

Experiment 1 was a RT-experiment. Words of masculine and feminine gender were presented to respondents by means of audial and visual channels.

In this experiment, we found the effect of marking members of grammatical oppositions. Unmarked words (masculine) are processed significantly faster than the marked words (feminine).

Experiment 2 assumed the presentation of abstract and specific words through audial and visual channels. A similar pattern was also found in the analysis of the category of concreteness.

The treatment of pairs of stimuli with two abstract values occurs significantly faster than pairs represented by two specific stimuli.

Keywords: word processing, grammatical gender, abstractedness

Hand gender cue effects on incremental language comprehension: an ERP study

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Psycholinguistic studies investigating grammatical and semantic (i.e. biological) gender knowledge effects on language comprehension have often manipulated the match between a linguistic context and words (e.g. pronouns) in a subsequent sentence (e.g. finding the word *her* after a sentence talking about a *policeman*; Hammer et al., 2008; Kreiner et al., 2009; Xu, et al., 2013). Gender cues can also be conveyed through a visual context. For instance, event-related brain potential (ERP) studies have shown that mismatches between a picture and the ensuing sentence affect sentence processing in real time (Knoeferle et al., 2011, Vissers et al., 2008; Willems et al., 2008;). We examined the effects of prior visual gender cues (in videos featuring male vs. female hands performing an action) on participants' ERPs as they listened to sentences containing a masculine or feminine actor name (translation of German object-verb-subject example sentence: 'The cake (obj) bakes soon Susanna/Tobias (subj)'). We manipulated the match between the gender of the hands and the gender of the actor's name (i.e. subject). At 'Susanna/Tobias', mean amplitudes were more negative (300-500 ms) for gender mismatches than matches. Additionally, mismatches (vs. matches) elicited more positive mean amplitudes, persistent over time (500-900 ms, see Fig. 1). Similar to linguistic contexts, both N400 and P600 effects were more pronounced at posterior than anterior sites. The cross-modal verification of gender seems to modulate different processing stages in comprehension.

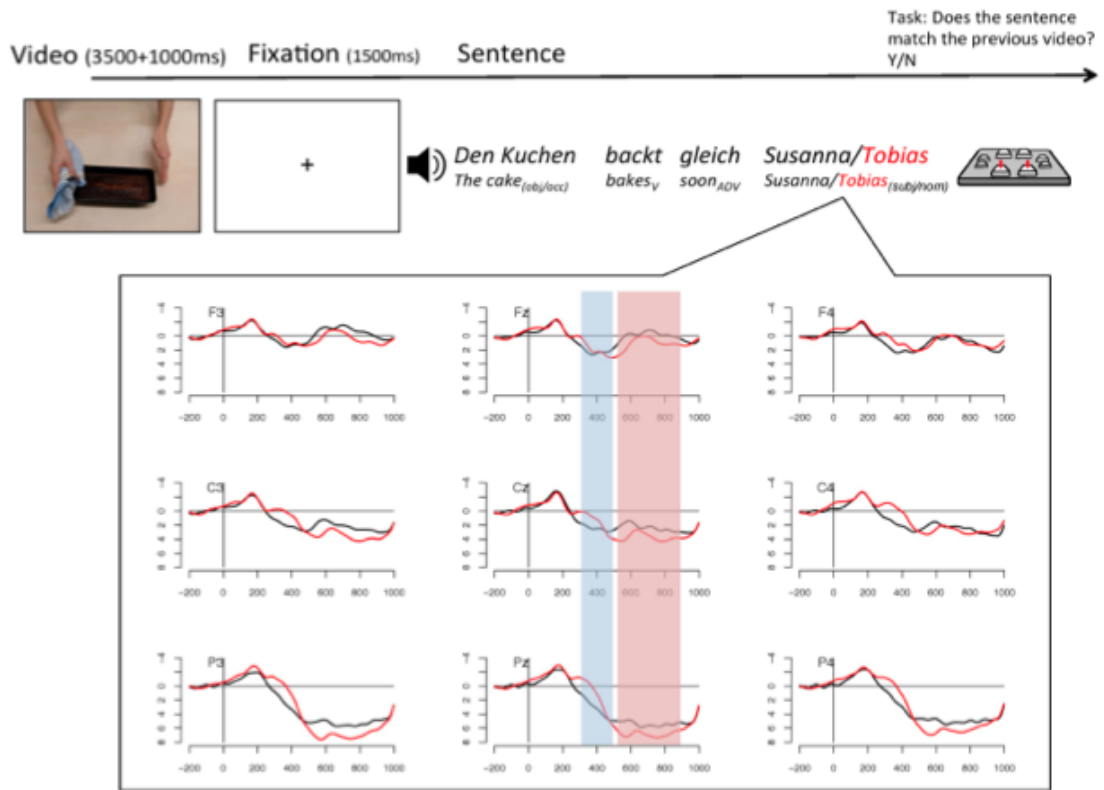**Keywords**: gender verification, cross-modal, language comprehension, N400, P600

Figure 1. Grand averages per condition for 9 electrodes (3 frontal, 3 middle and 3 posterior) time-locked to the subject (the blue and the red bars indicate the time windows for the N400 and the P600, respectively).

The Effect of Frame Semantic as a New Semantic Approach on Vocabulary Learning in L2 Learners

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The purpose of this study was to investigate two ways of teaching vocabulary in an English language class in order to determine whether Frame Semantics is a feasible and suitable tool with regards to students' vocabulary acquisition and culturally appropriate usage of vocabulary. A total of 46 university students enrolled in two fourth-semester English classes participated in this study. In the Control Group rote memorization techniques were used, while in the Treatment Group Frame semantics was utilized for the teaching and learning of vocabulary. The data was analyzed through quantitative methods. The quantitative data was derived from an online demographic survey, a vocabulary pre-test, two vocabulary post-tests (an immediate post-test and delayed post-test), a cultural appropriateness pre-test and two cultural appropriateness post-tests (an immediate post-test and delayed post-test). Analysis of the data indicates that contrary to previous studies, there is statistically significant difference between the two groups with regards to their cultural appropriate usage of the vocabulary items, and statistically significant differences were observed with regards to vocabulary recall and retention. Thus, the results indicate Frame semantics is suitable for vocabulary learning and teaching as it resulted in an increase of learners' vocabulary knowledge, including long-term retention.

Frame semantics is a theory that extends linguistic semantics to encyclopedic knowledge developed by Charles J. Fillmore (1982), and it is a further development of his case grammar (1968). The key point is that one can't understand the meaning of a single word without access to all the significant knowledge that relates to that word. Fillmore illustrates this by offering a frame of commercial transaction. This frame includes a person interested in exchanging money for goods (the Buyer), a person in want of exchanging goods for money (the Seller). The Buyer did or could acquire (the Goods), and the money acquired by the seller (the Money). Under this framework, it's possible to say that the verb BUY focuses on the acts of the Buyer with respect to the Goods, back grounding the Seller and the Money; that the verb SELL focuses on the acts of the Seller with respect to the Goods, back grounding the Buyer and the Money; that the verb PAY focuses on the acts of the Buyer with respect to both the Money and the Seller, back grounding the Goods, and so on, with such verbs as SPEND, COST, CHARGE, and a number of other outsiders to these. Such description was to point out that no one can be considered to know the meanings of these verbs who did not know the details of the kind of frame which provided the background information and motivation for the categories that these words represent. Its essence lies in that one would not be able to understand the word sell without knowing anything about the circumstances of commercial transfer, which at least involves, among other things, a seller, a buyer, goods, money, the relations between the seller and the goods and the money, the relation between the money and the goods, the relation between the buyer and the goods and the money and the like. Thus, a word activates a frame of semantic information relating to the specific concept it refers to.

Keywords: frame Semantics, vocabulary learning, rote memorization

Cognitive study of image schema and dying-mind in Tagore's NDE poems

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Image schema is a recurring dynamic pattern within our cognitive process (Johnson, 1987). It originates from bodily experience that projects our understanding of the world and death is the finite-state of this recurring schema patterns. The present study aims at analyzing image schemas (Johnson) and stages of grief (Kubler-Ross) in Tagore's near-death experience (NDE) poems which were written in the last ninety days before his death. Selected verses have been analyzed using benchmarks set by Johnson (1987) and Kubler-Ross (1969). Johnson (1987) prescribes for image schemas, such as, Container, Path and Force schema. Findings in Tagore's poems present Container schema (68%), Path schema (18%) and Force schema (14%). It is evident that dying-mind is centered to self, and, thus influences the type and frequency of all these schemas within it. Similar mental stages of grief: Denial, Anger, Bargaining, Depression and Acceptance as discussed by Kubler-Ross (1969) have been found in the poems. With respect to schemas found, relation between some linguistic forms, themes and mood of the poems have also been analyzed.

Keywords: cognitive linguistics, image schema, Kubler-Ross model, NDE poetry, Tagore.

Testing allocentric and egocentric spatial representations using the CAVE technique
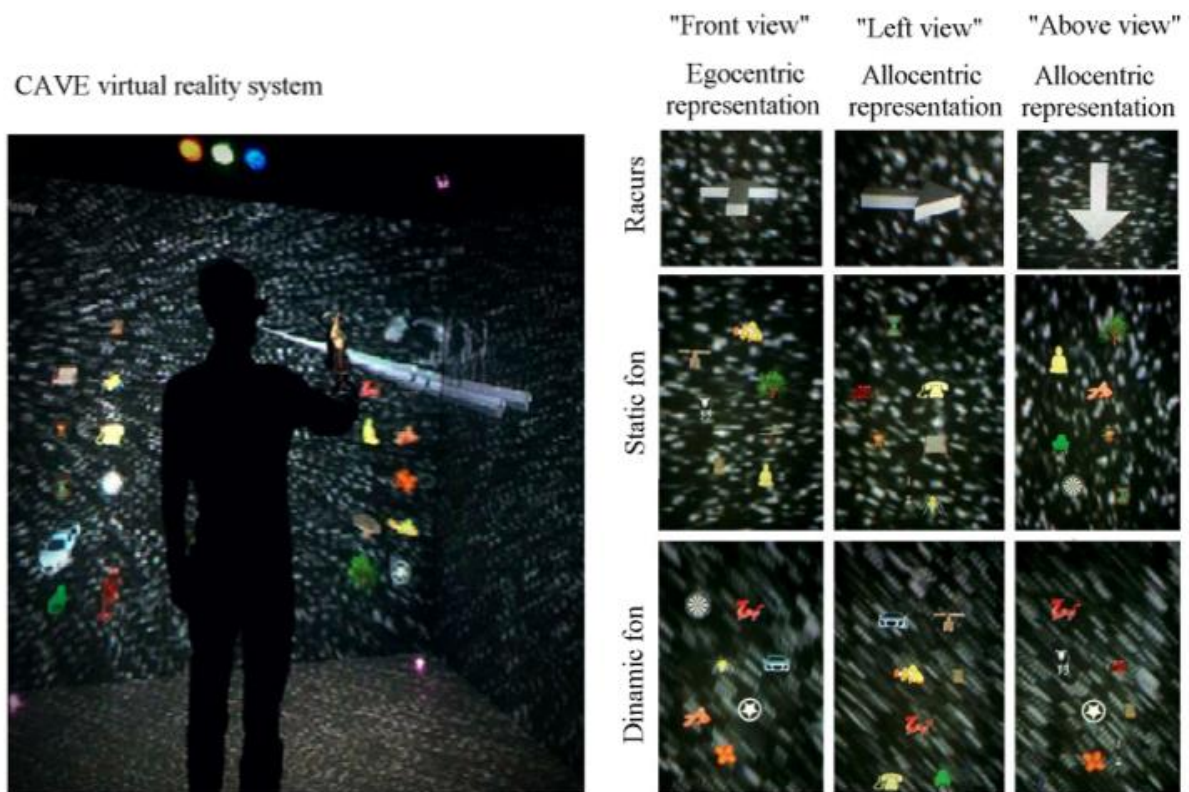
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It has been proposed the existence of two types of spatial mental representations coding successfully the objects localization: egocentric and allocentric. The first one specifies spatial information with respect to the observer's position and the second – to relative positions between objects. We investigated the accuracy of both spatial representation acquisitions using the CAVE virtual reality technology. Six unique virtual scenes were constructed consisted of 7 objects located in different 3D positions. 36 observers (age range 18—37) were tested. The participant's task was to remember the scene and then to reproduce object's positions in a virtual space using three imagined viewer's positions: 1) the front view (as if they would view the scene from the original view point), 2) the left one (the scene viewed from the left) and 3) the above one (viewed from above). To complete the task the participants chose virtual objects from the object's library and located it in a virtual space using flystik. During the execution object's locations in virtual space were recorded. The accuracy of spatial representations (perceived metric, topology and depth) was evaluated for each of three imagined viewer's positions. The results showed the egocentric representations (the front view) were more accurate than allocentric ones (left and above views) and "the above view" representations were more accurate compared with "the left" ones. The developed method may be effective to test the features of spatial representation.

Keywords: spatial representations, memory, allocentric, egocentric, virtual reality.

Prejudice reduction in word embeddings via Reinforcement Learning

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Word embeddings are novel language models made to represent natural language texts in a way that captures semantic connections among words and phrases. Word embeddings work by mapping a word to a n-dimensional vector such that a certain similarity metric (for the most cases, cosine sim- ilarity) between two vectors correlates with semantic similarity of words (measured by human beings).

This power brings a lot of unforeseen issues with. Word embeddings are trained on large corpora of human-made texts: Wikipedia articles, news, forum posts etc. Those texts, being written by human beings, inevitably capture people's prejudice about gender, race, religion, political views…

In the near future, with increasing need in AI systems able to represent semantics, biasedness of such systems can open new ways to strengthen existsing stereotypes, to instiualize them on an unforeseen level. This in turn leads to further enhancement of inequality and atrophy of diversity. For example: an automated education consulting system advises young women to apply for non-STEM programmes simply because of their gender and captured prejudice of women being unable to excel in STEM fields. The word embeddings are "intellectual" enough to capture human bias, but not "intellectual" enough not to capture them. This issue needs an algorithmic solution.

In this study we propose and implement a Reinforcement Learning-based prejudice reduction algorithm for word embeddings that does no harm to their structure. We evaluate its performance using simulated corpora and real Russian language corpora. The example of results is shown on the figure below.

Keywords: prejudice, gender and race bias, word embeddings, reinforcement learning, natural language processing
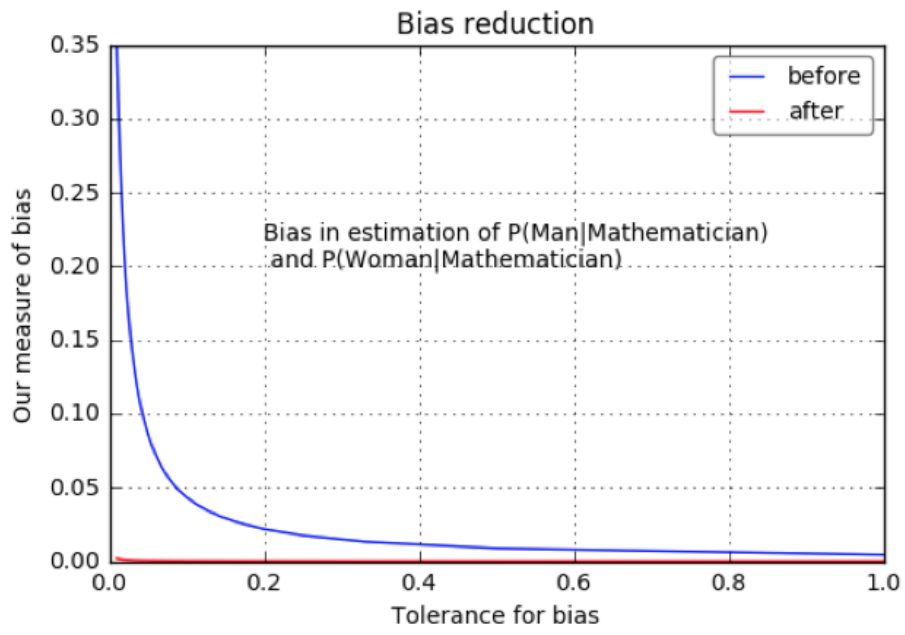
Figure 1: Result of prejudice reduction.

Non-invasive task-free protocol for assessing multiple levels of linguistic information processing

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Assessing the brain activity related to language comprehension is required in a range of situations (e.g. clinical or developmental assessment). Particularly in cases when the subjects' cooperation with instructions cannot be guaranteed (e.g., in neurological patients), a protocol is needed that could be independent from overt attention and behavioural tasks. Here, we present a novel paradigm which allows quantifying a range of neurolinguistic processes in the absence of directed attention towards sound stimuli and without relying on any overt behavioural responses. In a non-attend auditory sequence (~30 minutes long), spoken CV-syllables, meaningful words of different semantic categories, meaningless pseudowords as well as syntactically correct and asyntactic forms were presented equiprobably and pseudorandomly to healthy volunteers, who focused on watching videos during E/MEG recordings. All stimuli were tightly controlled acoustically. Meaningful words included action verbs, abstract verbs and concrete nouns. Syntax was manipulated using counterbalanced word-affix combinations matching or mismatching in tense or gender. Preliminary analysis of data revealed that, in addition to obligatory auditory brain responses, our protocol produced lexically and syntactically specific activations. E/MEG responses to meaningful words were larger than those to pseudowords, reflecting automatic word memory trace activation in the brain. Asyntactic inflections, in turn, led to activity increase over syntactically correct forms, indicating grammatical processing. Finally, action verbs showed a more frontal activity distribution than non-action items, likely due to semantically-specific motor cortex involvement. In conclusion, the new paradigm may be a subject-friendly and time-efficient tool to simultaneously test multiple language comprehension processes in the brain.

^bi	bide (vb. 'bite')	*bidet	*biden
^mi	mide (n. 'mite')	*midet	miden
^gi	gide (vb. 'bother')	gidet	*giden
^ni	**nide	**nidet	**niden

Stimuli used in the study: ^ CV-syllable, ** pseudoword, * asyntactic form of verb or noun

Keywords: EEG/MEG, ERP/ERF, brain, syntax, semantics

Hemisphericity Underpins the Emergence of Cognition and Tool-use

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What is the *essence* of human cognition? Ilyenkov's (1960) approach to essence and to understanding involves the *concrete universal* – something simultaneously material and itself an explanation of the phenomena in the domain under study (*cf.* Vygotsky's "unit of analysis").

Hemisphericity is identified as the relevant concrete universal for human cognition – the division of the brain into two relatively independent hemispheres, with uniquely extensive lateralization of anatomy and function, and the ensuing processing exigences.

To coordinate their activity, the hemispheres interact (a) directly across the commissures, (b) within the body, but critically (c) outside the body, mediated by *tools*. Human activity continually precipitates our cognition into the world, as artefacts (including language).

To coordinate, each hemisphere needs to second-guess the other.Theorists in influential enterprises around *prediction error minimization*, *embodied-enactive-extended cognition*, and *mirror neurons* have rightly prioritized activity, but have ignored hemisphericity despite the fact that interhemispheric communication possesses richer resources for learning and development, compared with intersubjective communication. Such theorists have preferred a positivist orientation to small 'fundamental' units.

Hemispheric asymmetry of anatomy and function generate a virtuous spiral in which increasingly sophisticated and nested cognitive tools are required for coordination.

In this perspective, the essential tool is *the other hemisphere*. Cranium and skin are not critical barriers. In development, when one hemisphere actively coordinates itself with the other hemisphere, it effectively uses that hemisphere as a tool.All later tool-use, involving hemispheric specialisms, can be developed out of this beginning, in phylogeny and in ontogeny.

Keywords: cerebral hemispheres, tool-use, universals, cerebral lateralization, interhemispheric communication.

Exploring Autistic Savantism with Computational Models Embodying Hemisphericity

Richard Shillcock, O. E. D. Fincham

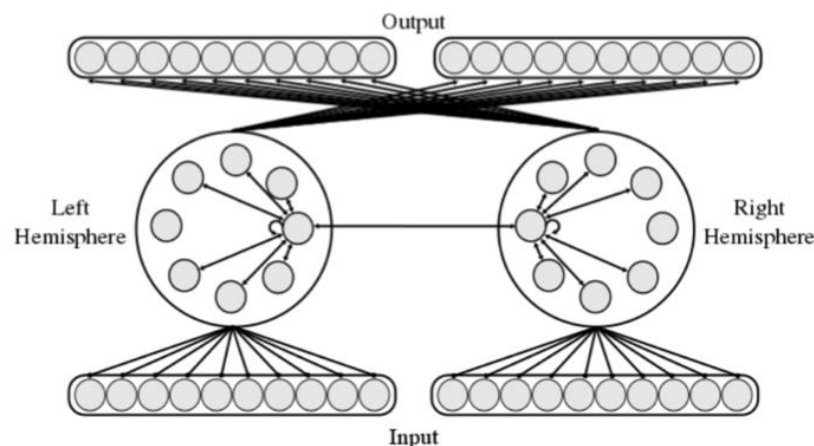*University of Edinburgh, Edinburgh, UK*

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Shillcock, Bolenz, Basak, Morgan and Fincham (*submitted*) have presented a successful model of Deary et al.'s (2003) data showing a sex difference in general intelligence across the whole Scottish population at ages 11-12 years, from the Scottish Mental Surveys of 1932 and 1949. Specifically, males are more variable than females and are disproportionally represented at *both* the top *and* the bottom of the intelligence distribution. Shillcock et al. have proposed the only *single-factor* explanation to date, one based on hemisphericity – the degree of hemispheric independence and lateralization of function.

Their implemented computational modelling involved recurrent neural networks, with 'male' networks being characterized as having greater hemispheric encapsulation,'female' networks having more 'callosal connections'; cf. Ingalhalikar et al.'s (2014) demonstration that the male brain is optimized for *intra*hemispheric connectivity, the female brain for *inter*hemispheric connectivity. Performance on a simple autoencoding task qualitatively replicated the pattern of greater male variability.

Here we extend this approach with a computational implementation of Baron Cohen's Extreme Male Brain hypothesis regarding Autism Spectrum Disorder. We report explorations of 'autistic savantism' in similar 'male' and 'female' networks tasked with learning simultaneously a number of different sets of patterns (each representing an individual 'cognitive skill'), but with computationally under-resourced architectures. We define 'savantism' as the very successful learning of one particular skill, with poor learning of all the remainder. We test the hypothesis that such savantism occurs more in the 'male' networks, characterized by greater hemispheric independence, demonstrating hemisphericity's role in cognition.

Keywords: autistic spectrum disorder, sex differences, hemisphericity, lateralization, Extreme Male Brain hypothesis.

Figure 1. The basic architecture of the model, showing variable *inter*-hemispheric and *intra*- hemispheric connectivity, defining 'male' and 'female' models.

Metaphor in the usage of the Chinese and Serbian words for "smell"

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Metaphor is used in everyday life, sometimes in purpose, and sometimes unconsciously. The perception for smell is universal to all the nations and cultures, but still, when we compare the usage of Chinese words for smell such as 香(xiang)" to smell nice" or 臭(chou)" to smell bad" in the metaphorical way, it is not always the same with the usage of the same words in Serbian language. Our cognition of the words for smell depends very much on our culture. How can the culture influence on the usage of such basic perception words – words for "smell"? The paper strives to explore the metaphorical usage of these words, find similarities and differences, in order to explain them from the cognitive and cultural aspect. The corpus is excerpt from the Chinese and Serbian relevant dictionaries and spoken language.

Keywords: metaphor, Chinese language, Serbian language, words for "smell", culture

An enactivistic metaphoric approach to the learning of mathematics

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We argue that an approach to the learning of mathematics based on *enactive metaphorising* can make a dramatic difference in the way children and learners in general perceive and construct mathematics. Indeed we cognize through enacting and metaphorising, processes shaped by a long evolutionary history that are usually thwarted by traditional teaching Metaphorising (even unconsciously) is a powerful cognitive tool allowing us to grasp or construct new (mathematical) concepts, as well as to solve problems in efficient and friendly ways. Enaction ("lying down a path in walking...") brings forth a world by concrete handling. Mathematical strategies emerge continually in the enactive interaction of solver and problematic situation. In our context, most relevant metaphorising is enactive and enacting entails embodiment and situation.

We report here on didactical experiences in actual classrooms, involving a broad spectrum of learners (primary to tertiary students, mostly not mathematically inclined, and prospective and in service teachers), suggested by our theoretical perspective, that lend themselves to ethnographical observation, besides didactical engineering. We find that the way learners enact and metaphorise determines their emerging ideas. Extreme examples include:

- Asking the students to toss 100 times a coin and *report what happened*. Different observers construct different phenomena here. Meaningful collective dynamics ensue. - Prompting the learners to metaphorise and enact first when trying to figure out the sum of the exterior angles of a polygon. Enacting various metaphors for a polygon enabled most of them to *see* and *feel* that the requested sum is a whole turn.

Keywords: Enaction, metaphore, mathematics learning, embodied

Does the choice of spatial reference frame depend on language and complexity of perceived relation?

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Spatial relations in English, German, Italian and Polish can be produced and interpreted regarding three reference frames: absolute, relative, or intrinsic, depending on the situation. Native speakers of these languages set the absolute perspective when referring to geographic space. That's not applicable to all languages, for instance in Tzeltal native speakers use the absolute perspective predominantly (Levinson 2003). The relationships between the located object and the relatum are expressed in these four languages using adpositions.

The aim of the talk is to show results of a questionnare study with 561 participants indicating that the interpretation of the examined dimensional spatial expressions depends on the language and the situation. Significant differences in interpretation of `in front of' and `behind' were found between German and English native speakers. Italian native speakers deviated most frequently from the egocentric assignment of sides regarding the interpretation of `to the right of' and `to the left of'.

Additionally, results of an ongoing mouse tracking study will be presented. This online experiment objects to figure out, which reference frame native speakers of these languages apply to interpret the simple spatial relations. Furthermore, it is investigated, whether participants change their perspective interpreting the complex spatial relations (supplemented by X). It means, whether participants interpret these complex situations from the own perspective, and cover themselves as origo or from the X' perspective and thus shift the origo. It is also relevant when the origo shift takes place and whether it depends on the predicate semantics.

Keywords: spatial expressions, reference frames, spatial relations, perspective shift, object categorization
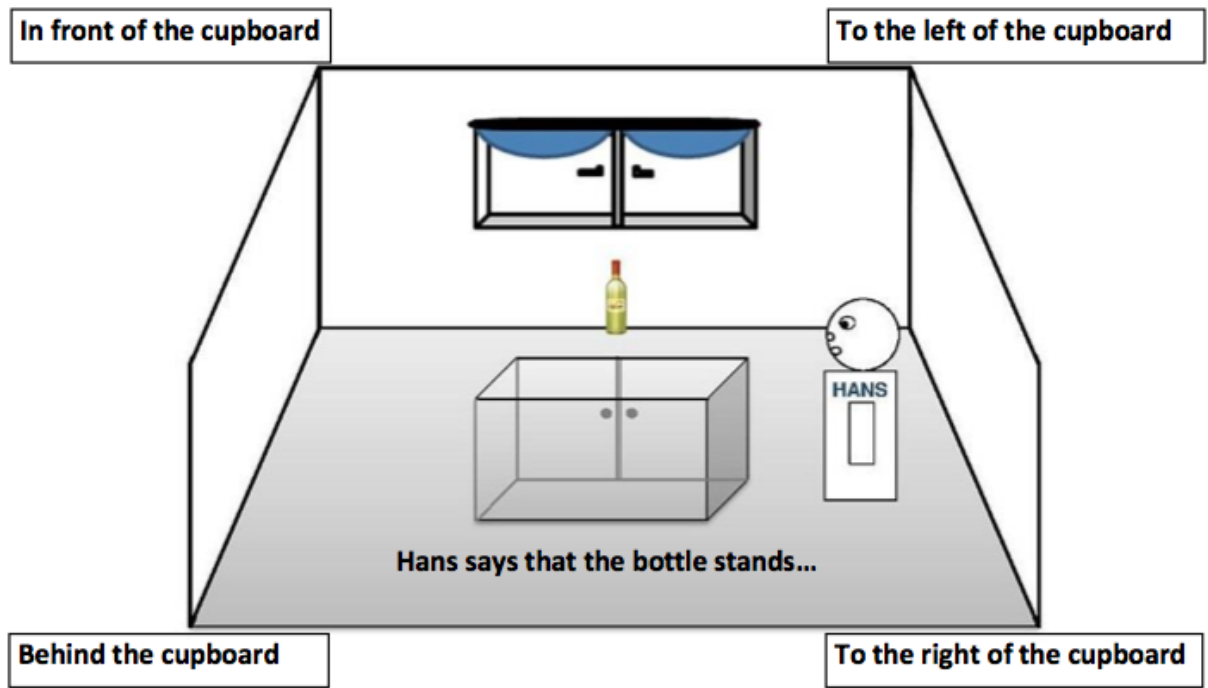
Figure 1: Selected intrinsic spatial situation from the mouse tracking experiment

Automatic lexical access in visual modality: Eye-tracking evidence

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Language processing has been claimed to be partially automatic, with some views suggesting full automaticity and attention-independence of at least early neural stages of language comprehension, lexical access in particular. Previous neurophysiological experiments reported early lexically-specific brain responses to visual stimuli presented parafoveally outside the visual focus under the condition of withdrawn attention. These studies have not, however, controlled for eye movements, leaving a possibility that participants may have foveated the stimuli and overtly processed them.

To address this, we used eye-tracking in order to scrutinize automaticity of lexical access and investigate spatial and lexical effects of brief unattended presentation of orthographic stimuli on eye movements. Participants were given a color-matching task in the central visual field with simultaneous brief presentation of linguistic stimuli (words, pseudowords and non-words) parafoveally. There was no task associated with linguistic stimuli and their location varied; participants were asked to fixate at the very center of the screen, and to react to color combinations in non-linguistic central stimuli.

Saccade analysis showed that participants were absorbed in the color-matching task and did not pay overt attention to the linguistic stimuli. The differences in proportions of stimulus-directed saccades were mainly affected by stimulus location and angle from the center of the screen. At the same time, recall tests indicated above-chance memory for the parafoveal linguistic stimuli. Our data support the notion of automatic lexical access as the words seem to be unattended and still processed covertly.

Keywords: automaticity, visual word comprehension, eye movements, parafoveal processing, visual asymmetry.

Functional connectivity of the inferior frontal gyrus depends on the verbal component of resting state cognition

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According to the task-based fMRI studies, the pars orbitalis of the left inferior frontal gyrus (IFGorb) is involved in semantic categorization, semantic retrieval, word generation, and semantic association. However human cognition may also engage semantic operations required for verbal thoughts and inner speech during active tasks as well as at rest. Moreover, ongoing integration of cognitive and emotional states is another essential part of the verbal self-reference. In the current study we set our goal to investigate resting state functional connectivity (rsFC) of the left IFGorb with regions, believed to play a key role in emotional processing and cognitive control. We collected resting state fMRI data from 20 healthy right-handed voluntaries, which quantified their thoughts and feelings during the prior resting-state session by filling the Amsterdam Resting- State Questionnaire (ARSQ). We calculated pair-wise rsFC between 34 regions of interest including bilateral areas of IFGorb and limbic network. We selected only significant values of the left IFGorb FC (pFWE<0.05) and checked them for correlation with the verbal factor of ARSQ. The FC of the left IFGorb with the right posterior cingulate gyrus, left insula, right thalamus, and left ventral striatum correlated negatively (p uncorrected <0.05) with the verbal component of ARSQ. These results suggest that functional interplay between brain regions processing semantic operations and emotions likely depend on the content of resting state cognition. Moreover, our findings imply that the left IFGorb could be a potential target for further research of the inner speech phenomenon.

Keywords: resting state fMRI, functional connectivity, pars orbitalis, inferior frontal gyrus, inner speech.

Critical thinking in EFL

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It can be expressed that, a student who does not know how to engage in critical thinking has not been effectively educated and has only learned how to recall previous information. For this reason it is vitally important for the student to grasp the skills that enable him to engage in critical analysis. Such skills are an essential part of learning English as a foreign language. The study of a language and the ability to engage in effective critical thinking are highly interconnected with one another. There are many different reasons for this. It must be understood that words convey ideas, and the particular ways in which words are utilized will have the effect of conveying a particular message.

It is for this reason that the process of language development should overlap with the study of proper functions with regards to linguistic meanings. One of the most concerns of this kind is that words are used within a context that is illustrative of their proper meaning. However, an individual that possesses powerful critical thinking skills is protected to such manipulation and possesses the skills with which truth and errors are perceived. For these reasons, it is essential that the study of English as a foreign language includes the development of critical thinking skills, leading to a more holistic education in the process.

Eye that space up: does the word affect memory about location?

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Previous research showed that task-irrelevant spatial information could affect content in the visuospatial working memory, if the irrelevant information is salient enough, for example it represents visually salient distractor/object. The visual distractor is supposed to activate part of the space that influences another piece of spatial information that is not visually available but stored in the internal spatial map created by rehearsal. Another line of studies revealed that word meaning that conveys spatial information (e. g. words 'up', 'down', 'left', 'right') is able to activate part of the space and 'interact' with the word physical position (a spatial Stroop effect).

Current study was aimed to combine two fields of research and investigate whether spatial information caused by linguistic stimuli would affect two stages of visuospatial working memory: location maintenance and location recognition, even if word meaning is task-irrelevant. The tasks in both experiments were to memorize exact location of a dot, to perform intervening task during location maintenance and, finally, to recognize the dot location. In the first experiment no words were presented to test the applied paradigm in absence of semantic content. In the second experiment a modified version of Stroop task was used, that is the word down or up was always printed within the dot that has to be memorized and then recognized. Results of two conducted experiments revealed visual field asymmetry, which was elicited by both 'up'/'down' memorized locations and words up/down. Specifically, the word down and the 'down' location disruptively influenced maintenance of the visual location, whereas the word up and the 'up' location mostly ensured the high-level performance during that stage. Location recognition, however, was influenced only by words but not by physical location of the stimuli. Here, too, the word down had its influence on the processing; moreover, the influence was a destructive one.

Both experiments clearly demonstrated that not only salient distractor affected memory of visual location, but also a space-related word was able to activate part of the space and have an impact on the two memory processes.

Keywords: visual working memory; spatial location; language processing

The role of aspect in Anaphora Resolution

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It has already been found that topicality plays a key role in Anaphora Resolution (AR). Topicality is usually related to the grammatical role of subject. There are several studies the results of which have proved the strong subject preference when it comes to resolving the anaphora of null ambiguous elements. However, the phenomenon has not so far been associated with purely grammatical features. Consequently, the aim of this paper is to test the potential interaction between aspect and topicality in Spanish language. Specifically, it investigates whether aspect shift (AS) causes topic shift (TS) and, hence, leads to reverse AR preferences.

The two hypotheses of this study can be formulated as follows:

  i) In texts with aspect shift the participants will mostly identify the previous object as the antecedent.

  ii) The preference reversal will be more frequent in the perfective-to-imperfective cognition.

The findings of the current study fail to confirm the primary hypothesis, which means that they are consistent with those from previous studies. The participants mainly choose the most informative argument, the subject. Particularly, the results show that aspect shift (AS) does not necessarily lead to topic shift (TS).

Concerning the secondary hypothesis, it is confirmed by the findings. The directionality of the AS plays a role as well. Specifically, in this particular condition the text ends with imperfective verbs imposing a non-telic interpretation of the event. This provides the object with the feature of activeness, which would be cancelled by an episodic interpretation.

Keywords: anaphora resolution, topicality, aspect, shift

Prosodic boundary, reading time and pace as predictions for relative clause attachment in ESL

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A great number of studies verified different prosodic cues to relative-clause (RC) attachment in English as L1 and L2 (Fodor, 1998, 2002, 2002a, Maynell, 2000; Carlson et. al. 2001; Jun, 2003; Dussias, 2003, Dekydtspotter et.al. 2008; Hwang et. al. 2011; Zahn & Scheepers, 2015). The controversial one is informative prosodic boundary (Clifton et al., 2002) such as in (1) that reliably biased listeners to assume a high-attachment (HA) interpretation:

(1) The criminal shot the servant of the actress [Boundary] who was almost deaf.

This boundary could inhibit the pace and reading time of a whole sentence as well as critical fragments (servant - N1, actress –N2, who was almost deaf – RC, etc.). In reading aloud task such boundary effect can be controlled by a comma insertion (Steinhauer & Friederici, 2001; Kerkhofs et. al. 2008).

The aim of presented study was to verify this effect in L2 English sentences processing by L1 Russian speakers (fluent L2 English speakers) because of well-researched different RC-attachment preferences in these languages: high-attachment for English and low-attachment (LA) for Russian (Федорова и соавт., 2007). The aim was to find any significant acoustical predictions for HA vs LA preferences in comma/boundary and no comma/boundary condition.

Results. A mathematical model using logistic regression was constructed for the analysis of predictors of HA vs. LA preferences. The original model included quantitative variables (such as pace and reading times of each sentence and critical fragments (N1, N2, RC)) and one categorical variable (the presence or absence prosodic break) as HA/LA predictors. The model showed lack of statistical significance (chi-square test 14.02, df=7; p = .051).

In the second stage two predictors (sentence pace and N1 pace) with the lowest statistical significance were removed from the regression analysis. This improved model is presented in Table 1 with acceptable significance level (chi-square = 12.72; df=5; p = .026). The coefficient values indicate that the LA predicted by a high N2 pace, high RC pace and reading latency. LA can be also predicted by a prosodic break while lack of such break indicates a greater probability of HA. The accuracy of HA and LA prediction is quite significantly different: although the overall accuracy is 70% of correct classification, for LA it is only 31%. This shows that reading time, pace and prosodic break could accurately predict HA but not LA.

Keywords: relative clause attachment, prosodic boundary

Predictor	Regression coeff. B	Std. Error of. B	Wald test	df	p-value
N2 pace, syl. per sec.	0,51	0,23	4,77	1	0,03
RC pace, syl. per sec.	0,80	0,41	3,88	1	0,05
Sentence reading time, ms.	-0,65	0,52	1,55	1	0,21
RC reading time, ms.	2,41	1,07	5,05	1	0,02
Prosodic Break before RC	1,03	0,56	3,35	1	0,07
Constant	-7,96	3,64	4,78	1	0,03

Table 1. A logistic regression model to predict HA and LA (N = 90)

How do emotional valence and personal traits affect lexical decision? Evidence from Russian[10]

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A great number of modern behavioral studies postulate the idea that emotional content of verbal material affects the speed of visual word recognition in various cognitive tasks (Vinson et al., 2014; Citron et al., 2014; Yap et al., 2015, etc.), but emotional factors (e.g., *emotional valence*) are still not verified in current models of word recognition (Kuperman et al., 2014). Several studies were conducted on the material of English, but there is lack of experimental studies on the material of languages other than English.

The present study aimed to reveal a word's emotional valence effect in automatic lexical processing using Russian lexical database ENRuN (Lyusin & Sysoeva 2016). Two lexical decision tasks were conducted in 92 Russian speakers (N=44 in *yes/no* LDT; N=48 in *go/no-go* LDT). The experimental blocks were equal in two studies and comprised 120 Russian emotional nouns retrieved from ENRuN database that were either positive (N=40), negative (N=40) or neutral (N=40), and 120 nonwords.

Using mixed-effects models a significant effect of word's emotional valence was obtained: positive words were processed much faster than negative and neutral ones and negative words were processed much slower than positive and negative ones. This result could be interpreted in terms of *attentional vigilance*: heightened and/or extended attention to negative stimuli which would slow any decision (such as lexical decisions) on other aspects of the stimuli (Erdelyi, 1974 Pratto & John, 1991; Fox et al, 2001; Ohman & Mineka, 2001; Estes & Adelman, 2008; Larsen et al., 2008). The slight effects of emotional valence × word frequency and emotional valence × subjects' affectivity were also obtained. Positive emotional valence had stronger effect on low- frequency words than on high-frequency words. The subjects with positive affectivity had slower responses to positive words than subjects with negative affectivity. These results are close to Kuperman's results (Kuperman et al., 2014) and give some empirical evidence from affective word processing in language other than English.

Keywords: visual word recognition, emotional valence

Peculiarities of the semantic space of concepts "resources" and "potential" in groups of students with different IQ level

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Concept is a fragment of an individual picture of the world. The higher is the differentiation and integration of the concept, the greater is the productivity of human life (Chuprikova, 2007; Kholodnaya, 2002, 2012; Volkova, 2013, 2014). The purpose of the paper was to compare the peculiarities of the semantic space of the concepts "resources" and "potential" in groups of students with different IQ level. Participants of the study were 117 Russian students aged 18-24 years (58,1% girls). Diagnostic complex included the assessment of intelligence (SPM; Raven) and semantic differential scale. Participants were asked to choose where his or her position lies, on a scale between 34 bipolar adjectives against a series of bipolar, seven-step scales defined by verbal opposites each of which was assigned scores -3, -2, -1, 0, 1, 2, 3 respectively. Mathematical date processing was carried out by using the IBM SPSS-22 software. We applied hierarchical cluster analysis (Ward's method) for reviling peculiarities of the semantic space of concepts. The data obtained showed in groups of students with IQ above the average 5 clusters in the semantic space of concept "resources" and 3 clusters in the semantic space of concept "potential". In groups of students with IQ below the average we relieved 4 clusters in the semantic space of concept "resources" and 1 cluster in the semantic space of concept "potential". The results of the study showed that more differentiated semantic space of the concepts "resources" and "potential" corresponds to the higher IQ level.

The Conceptual Metaphors in the Cognitive Domain of Law—Based on China's Company Law

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With the deepening of rule of law and judicial reform, the value of forensic language in respect of legislation, judiciary, law enforcement and dissemination becomes higher and higher. The study of legal metaphors is one branch of forensic language studies that deserves attention. Among the metaphor theories, George Lakoff and Johnson's Conceptual Metaphor Theory (CMT) is a revolutionary and widely acknowledged one. They pointed out that conceptual metaphor exists ubiquitously in our daily communication and even in thoughts and actions, and it can reflect the construction of speaker's concept system, which is the key to human cognition studies (Lakoff& Johnson, 1980). Based on the Conceptual Metaphor Theory, this paper aims to investigate the conceptual metaphor in the cognitive domain of law. The authors conducted a text analysis on the company law of the People's Republic of China (PRC), and extracted five categories of conceptual metaphor centering on A COMPANY IS A LEGAL PERSON, including its identity, rights, obligations, liabilities and relationship with other companies, and the obligations of a company appears in the majority.

Keywords: conceptual metaphor, law, company law, cognitive domain.

Visuo-semantic size congruency effects in concrete and abstract word recognition

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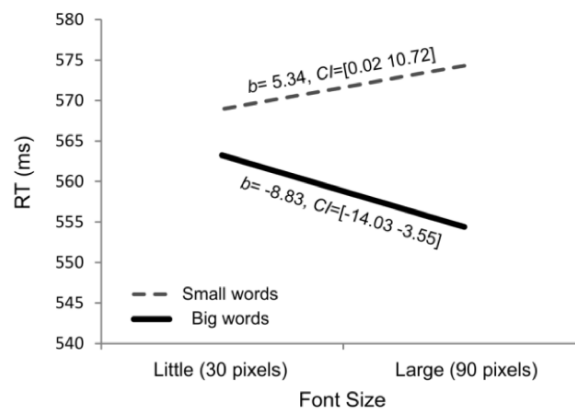
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Previous research has demonstrated a processing advantage for semantically ''big'' versus ''small'' words having either concrete (e.g., *jungle* vs. *needle*) or abstract (e.g., *trust* vs. *trace*) meanings [1,2]. This bigger-is-faster effect has been attributed to differential lexical processing of "size" based on visuo-spatial sensory features associated with concrete words and on emotional qualities associated with abstract words [2].

The current research investigated the visuo-spatial grounding of size in concrete and abstract words by examining the interaction of visual font size and word semantic size in a lexical decision task (notably, without explicit judgments of font or semantic size). Fifty participants were tested on 220 target words in a 2 (Concreteness: Concrete, Abstract) × 2 (Semantic Size: Big, Small) × 2 (Font Size: Large, Little) within-participants design.

Using maximal linear mixed models, we found that concrete words were processed faster than abstract words [b=-16.48, t=-4.64, p<.001], and that semantically big words were recognized faster than semantically small words [b=-12.83, t=4.05, p<.001]. There was also a Semantic Size × Font Size interaction [b= -14.18, t=-4.04, p<.001], indicating a visuo-semantic size congruency effect (**Figure 1**). No other effects were significant.

Figure 1: Semantic × Font Size interaction

The findings demonstrated facilitated processing when the semantic size and visual font size were congruent, for both concrete and abstract words. The latter is surprising because, unlike concrete objects, abstract concepts are not directly linked to our sensory-motor experiences of the physical world. The size congruency effect in abstract words may be metaphorical in nature [3], or mediated by font size-emotion generalizations [4].

Keywords: sematic size, concrete, abstract, word recognition, lexical decision

Image schema of time perspective in autobiographical Self-Narratives: narrative coherence and identity styles

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Time representation in a cognitive scheme of a narrative is known (Bruner, 2004; Ricœur, 1998) as a basic cultural instrument of social life meaning construction. M. Johnson (1987) argued that image schemas as embodied sensorimotor experience used in the processing of a "course of life" idea. Time perspective representations as a "pass", "link", "cycle", "center-periphery", "scale" or "force" scheme were empirically studied in autobiographical self-narratives to identify its role in identity processes on 62 autobiographies of three generation members: BB (1943-1963), X (1964-1983), Y (1984 – 2003) [Strauss, Howe, 1997], age 13-80. Four types of global narrative coherence: temporal, biographical, causal, and thematic (Habermas, Bluck, 2000) in self-narratives was proved to have specific autobiographical time representation patterns based on different image schemas (Fig. 1). Set of 16 words semantically correspondent to them was made and measured according to the subjective experience of the "time in my life"(N=454, age 17 до 62, Likert scale). Age, gender, generation membership (socio-cultural context), narrative and discursive patterns and identity status were proved to covariate with image schemas under metaphoric representation of time perspective. Identity style (ISI-5, M. Berzonsky (Isaeva, Zaitseva 2015) of 25 people (10 m, 15 f), age 18– 25) and 18 people (4 m, 14 f) age 35–55 (generation X:1961–81) was scored. Qualitative analyses of their autobiographical essays and biographical interviews allowed to describe patterns of metaphorical representation of autobiographical time (personal and social) In different identity styles. Results are discussed in conceptual frame of social-cognitive mechanisms of narrative identity construction.

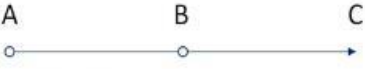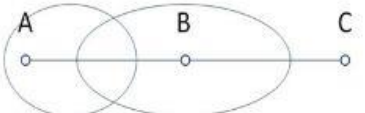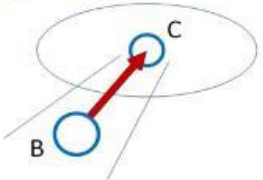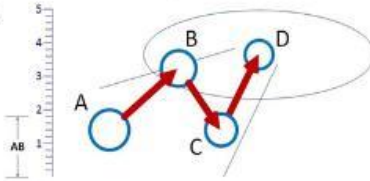**Keywords**: image schema, time perspective, self-narrative, identity, narrative coherence

Coherence of life-narrative (Habermas T., Bluck S., 2000)	Image schema (Johnson M., 1987)	Understanding of time by spatial and force metaphors	Image schema of life course
Temporal	Pass	time as a chronological series of events	
Biographical	Life cycles; barrier	time as a space ("topos") of normative behavior	
Causal	Centre-Periphery, Link; Force	time as a measure of changes, the subject difference from himself.	
Thematic	Scale; Force	time as a dynamic process of changes; the rhythm and tempo of life efforts	

Figure 1. Image schema of time perspective and narrative coherence in Self-Narratives (IPA, discursive and narrative analyses results)

Embodied Education through a multimodal interface

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The title of the study "Embodied education through art and theatre" indicates the perspective that this study therefore assumes. In particular, Embodied Education includes the contributions of Embodied Cognition, that is, that area of psychological research that represents a "new paradigm" for psychology, shifting from the abstractness of classic cognitive psychology to physicality. "Art" and "Theatre", visual and kinesic channels, are the aspects of physicality that Embodied Cognition (Rizzolati 1988, 1996; Fadiga, Craighero 2003) addresses, based on the discovery of the so-called MNS, Mirror Neuron System (Gallese, Rizzolatti 1996).

The subtitle of the thesis, "Experimentation of a multimodal interface" indicates a construct, or "didactic mediator" (Damiano 1989), created in order to integrate the three levels identified by Bruner, focusing in particular on the iconic-representative and enactive stages rather than symbolic. The intent is to highlight how and if Embodiment functions in this set.

The hypothesis - or "question" of the research expressed in the title aims to identify "Embodied Education" (a rare term and one that is often confused with Embodied Cognition) through the didactic experience, in a pedagogical direction that corresponds in particular to the research on Montessori and Embodied Education (Rathunde 2009) or even more pertinently on Embodied Education as a convergence between phenomenological pedagogy and Embodiment (Francesconi, Tarozzi 2012).

The methodological part starting from phenomenology applies the three moments of reduction-description-variation in the reconstruction of a pedagogical experience pädagogische Erfahrung (Brinkmann 2015), first addressing variation as an abductive dimension of thought (Peirce 2003), the "thought of discovery".

Keywords: Embodied Education, multimodal interface, Art, Theatre

Atypical processing of semantic associates in adults with a history of institutionalization[11]

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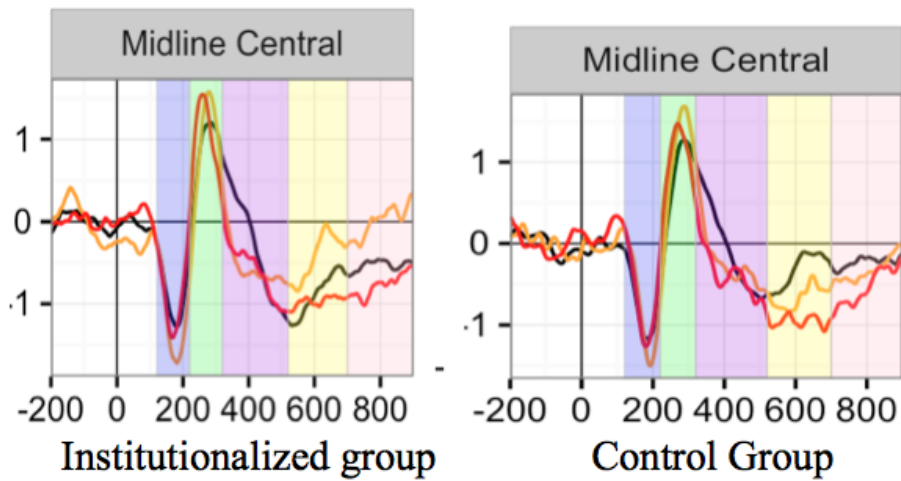
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Children who are left without parental are most commonly placed in institutional care in the Russian Federation. A large body of literature suggests that children raised in orphanages demonstrate social-emotional and cognitive development deficits (Muhamedrahimov et al., 2005; van Ijzendoorn, 2005), including deficits in language development (Glatzhofer, 2010; Loman et al., 2009). However, relatively little is known about the residual effects of institutionalization on specific cognitive processes, especially with respect to language development. Our ERP study focused on language processing in the sample of young adults - 28 with a history of institutionalization (20 males M=21.62 yrs, SD=6.21) and 31 age- and SES-matched control adults raised by biological parents (18 males $M = 22.03$ yrs, SD =5.13). We used a cross-modal picture-word paradigm (Kornilov et al., 2015) to elicit the N400 component while registering EEG. The experiment included one match and three mismatch conditions (unrelated word, semantic associate, phonologically related word). The results indicate that adults with a history of institutionalization do not demonstrate the N400 effect in the semantic associate condition (p=.043). At the same time, in the control group of adults, we found a robust N400 between 520 and 720 ms post-stimulus. The pattern of results suggests that residual effects of institutionalization can be observed at the neural level, most evidently when the task demands are high.

Keywords: institutionalization, residual effects, semantic processing, ERP, N400

Graph 1. Average waveforms over midline central electrode clusters in response to 3 experimental conditions. Purple line – average waveform for Match condition; orange line – average waveform for Semantic associate condition; red line – average waveform for Semantically Unrelated condition.

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