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Program

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Káldi Tamás

10:15 Relationship between cognitive control and the ability to recover from a garden-path during sentence comprehension
Enikő Ladányi

10:30 Implicature derivation and executive functions
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11:00 Self-initiated tones: feedback to optimize tone-eliciting
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**12:30 Eye-tracking and EMG supported 3D Virtual Reality –
an integrated tool for perceptual and motor development of children
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12:45 The characteristics of multicultural team work in light of team mental model and cognitive consensus

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Abstracts

Implicature derivation and executive functions
Andrea Balázs

Children under the age of 9 have been found to accept sentences with scalar implicature expressions even if they are underinformative in the given context (Noveck 2001). In contrast, Katsos and Bishop (2011) showed that children as young as 5 produced adult-like responses in a scalar implicature derivation task when they were instructed to give "true", "false", or "neither true nor false" responses, which the authors explain by the hypothesis that young children recognize but tolerate underinformativeness. Using the same ternary response sentence-picture verification task, we investigated 3 to 8 year-old children's interpretation of Hungarian pre-verbal focus sentences, which giving rise to scalar implicatures derivation in adult participants. While children older than 6 indeed showed an overall adult-like response pattern in the sense that underinformative sentences had higher average scores than false sentences but lower average scores than optimally informative sentences, large individual variation was found within and across all age groups.

Furthermore our study looked at the hypothesis proposed by e.g. Foppolo et al (2001) that these differences may be explained by differences in non-linguistic factors such as executive functions. Therefore the relationship between 3 to 8 year-old typically developing Hungarian children's derivation of scalar implicatures and the following cognitive abilities, each of which were measured by a modified version of standard tasks were tested.

(i) Cognitive flexibility or shifting, which is needed to be able to switch between the literal and the pragmatic meanings if the situation requires;

(ii) Inhibitory control, which is needed to suppress the infelicitous semantic meaning;

(iii) Ease of updating, which is needed to update the current focus attention following the inhibition of the alternative.

The results show that children who showed better performance on executive function tasks performed better on the preverbal focus task as well. Furthermore, executive functioning turned out to be a better predictor of focus interpretation than chronological age. We conclude that executive functioning is an important component in scalar implicature derivation.

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Individual differences in perceiving multistable sound sequences are related to Near-Infrared Spectoscropy functional network characteristics

Dávid Farkas, Susan Denham, Alexandra Bendixen, István Winkler

When the sensory input is ambiguous, individuals differ not only in how much they switch between the possible percepts (perceptual bi-/multi-stability; e.g. Aafjes *et al.*, 1966; Kondo *et al.*, 2012), but, at least for an auditory multistable stimulus configuration, their responses remain similar even with over a year the first test and the retest (Denham *et al.*, 2014). Correlations between these stable characteristic individual switching patterns and some executive functions and personality traits have been previously shown by Farkas *et al.* (in prep). Here, we report some of the results obtained in a study measuring Near-Infrared Spectroscopy (NIRS) to identify the functional brain networks during the perception of ambiguous auditory stimuli, exploring the relationship between these brain measures and the individual switching patterns. The main dimension which participants' behavioral responses differed from each other turned out to be the same "Exploration" dimension that was also found in our previous study. Individual variability in the characteristics of the functional brain networks, which was derived from deoxygenized hemoglobin concentration changes, were found to be related to the participants' position on the "Exploration" dimension as well as to correlates of this dimension: the less hierarchical the functional brain networks were the more "explorative" tendencies were found.

The exhaustive interpretation of the Hungarian pre-verbal focus: entailment or implicature?

Tamás Káldi

Through an eye-tracking experiment we investigated whether the meaning exhaustive conveyed by placing a constituent immediately before the finite verb in Hungarian (pre-verbal focus, pre-Vf) is semantic or pragmatic by nature. While it is a fact that pre-Vf may be interpreted exhaustively, i.e. the constituent before the verb may be interpreted as the only entity to which the predicate holds, the status of this exhaustive interpretation is subject to debate. Traditional accounts consider the exhaustive interpretation to be semantically determined (i.e. an entailment), while an alternative pragmatic account proposes that exhaustiveness is a context dependent pragmatic phenomenon (i.e. an implicature) and it is implicated rather than entailed.
The experiments conducted so far have looked at off-line data, since reaction time cannot be measured because of the crucial word order difference in the sentences types at hand. In offline tasks, however, only the 'end product' of an interpretational process can be measured but not its progress. In an attempt to improve the methodological tools used to investigate pre-Vf interpretation, we developed an eye-tracking experiment using the visual word paradigm in which processing related information is – at least indirectly – accessible.
In our experiment we compared the interpretation of lexically marked focus (*csak*-focus; ***Csak a kivit*** *vágta félbe*), pre-Vf (***A kivit*** *vágta félbe*), and neutral sentences (*Félbevágta a kivit*). Participants had to choose the image(s) (depicting an inclusive or exclusive scenario) best representing the meaning of the auditorily presented test sentences. The choice of image (behavioural data), and the ratio of dwell time (DT) on the target image to DT on the alternative image (eye-tracking data) were recorded. We expected *csak*-focus to be unambiguously

interpreted as exhaustive, pre-Vf to show some ambiguity regarding exhaustive interpretation and clear ambiguity in the case of neutral sentences. In order to validate the experiment we conducted a baseline measurement where the processing of sentences containing nouns coordinated by *és* ('and') and *vagy* ('or') were compared. It has been shown by an earlier experiment that the interpretation of these connectives is tied to entailment and implicature, respectively. The behavioral and DT data of our experiment reflected the expected difference; hence, we concluded that the method was successfully validated.

In the experiment on focus we expected the pre-Vf condition to show an eye-movement pattern similar to the *vagy*-condition and the *only*-focus condition to show an eye-movement pattern similar to the *és*-condition. Our first results, however, showed an unexpected pattern: participants gave an exhaustive interpretation to all sentences in all conditions. We argued that this pattern might have been the result of forced choice effect, since participants could choose only one image according to the experimental task. Thus, we redesigned the experiment. In the second experiment participants could choose any number of images they considered to represent the sentences they heard. The results of the modified experiment are in line with our expectations, namely, that *csak*-focus patterns with the *és*-condition, and the pre-Vf condition patterns with the *vagy*-condition. Pragmatic based theories have been corroborated.

Learning reward contingencies from prediction error: Age-related aspects of sequential risk-taking propensity in the Balloon Analogue Risk Task

Zsófia Kardos [a, b], Roland Boha [b], Andrea Kóbor [c], Ádám Takács [d], Brigitta Tóth [b], Bálint File [b, e], Márk Molnár [a, b, e]
a) Department of Cognitive Science, Budapest University of Technology and Economics, Budapest, Hungary
b) Institute of Cognitive Neuroscience and Psychology, RCNS, HAS, Hungary
c) Brain Imaging Centre, RCNS, HAS, Hungary
d) Institute of Psychology, Eötvös Loránd University, Budapest, Hungary
e) Faculty of Information Technology, Pázmány Péter Catholic University Budapest, Hungary

The Balloon Analogue Risk Task (BART) is suitable for the investigation of progressive expectation formation processes based on reinforcement learning. These expectations are assumed to have an effect on behavior by guiding it towards reward maximization through neural processes constantly signaling not only whether the outcomes of actions reached the task goals or not but also about to what extent these could fit the preconceptions. The goal of the present study was to use the BART in an electrophysiological setting and compare data obtained in young and elderly subjects since no data are known on the age-dependent patterns of risk-taking behavior and their electrophysiological correlates under these circumstances.

During task-solving each additional pump on a virtual balloon increases the likelihood of burst but deciding to go on pumping also increases the chance to collect more reward. Events associated with these two possible outcomes (increasing reward or balloon burst) provide appropriate visual feedback about the consequences of the prior decision, ensuring the refinement of the behavioral adaptation to the task – whether to go on or collect the money already earned. EEG was recorded from 17 young and 18 old participants and event-related potential analyses were performed within the time window of the last positive feedback (balloon increase) before

balloon burst and before collecting the money, respectively, assuming that these stages reflect different levels of expectancy about the possible outcome.

Age-related differences in risk-taking propensity was not found to be significant, suggesting that both groups achieved similar total outcome, although via possibly various strategies denoted by the different exploratory behavior of the two groups. Nevertheless, magnitude of feedback-related ERPs changed only in the young group as a function of expectancy but not in the old, which could possibly indicate that reward contingencies had less effect on the elderly than on the young. These findings indicate that the characteristics of ERP responses and the different exploratory behavior observed in the two age groups probably correspond to altered processing of reward contingencies with age.

Physiology in human-computer interaction: experiences and future plans

Máté Köles

The level of mental effort needed to perform a task can characterize the interaction between human and computer. There is an abundance of self-report, subjective rating based methods of assessing this level of effort, but their feedback lacks the speed needed to construct a truly dynamic and adaptive system. Physiology based methods can offer online and unbiased feedback on mental effort. In my presentation I will introduce the methods that proved most useful and the projects in which they were applied. Results from studies using the mid-frequency (0.04-0.15 Hz) power of the heart rate variability and pupil diameter change will be presented along with possible approaches to integrating EEG to the framework as well.

The role of lateral occipital cortex in perception of noisy faces

Petra Kovács

The functional specialization of the extended network of face processing is one of the hottest topics of face perception literature. Beside the core system of face processing, it has been shown that the object-selective lateral occipital cortex (LOC) plays an important role in the discrimination of noisy face images. An enhanced activity of the LOC during the processing of phase-randomized as compared to intact faces was seen in studies using functional magnetic resonance imaging (fMRI). Furthermore, new insights of resting-state fMRI revealed that the participants' ability to discriminate the identity of noisy face images is depend on intrinsic functional connectivity between bilateral fusiform face area (FFA) and bilateral LOC. In the present study, we investigated the causal role of the LOC in noisy face processing by transiently disrupting neural activity in this region using fMRI-guided transcranial magnetic stimulation (TMS) during which participants performed a gender discrimination task with intact and noisy face images. Build upon a former study we were also interested in the timing of the effect, therefor we applied different timing for the stimulation (100 ms, 150 ms, 200 ms, 220 ms, 250 ms after stimulus onset). To control the effect of the stimulation we implied inverted faces, whose processing also have been shown to be affected by stimulation of the LOC. Furthermore, collection of data is still in progress.

Relationship between cognitive control and the ability to recover from a garden-path during sentence comprehension

Enikő Ladányi

According to recent theories of sentence comprehension recognition of individual words automatically triggers syntactic and semantic analysis of the sentence. When more than one analyses are available, the most frequent one will be the most dominant and in most of the cases it turns out to be the correct analysis of the sentence. However there are sentences in which initial information points towards an incorrect analysis which has to be suppressed based on later evidence and another analysis has to be promoted. These sentences are called garden-path sentences. For instance in the sentence *Míg a vadász lőtt egy szarvast láttak az erdőben* ('While the hunter shoot a deer was seen in the forest.') the *deer* is first analyzed as the object of the verb *shoot* but turns out to be the subject of the subordinated clause when the verb *see* appears. Novick and his colleagues proposed that cognitive control - which is our general ability to suppress irrelevant and facilitate relevant information to think and act in accordance with our internal goals - is necessary to override the initial automatic characterization of the input and found supporting evidence for their hypothesis (Novick, Trueswell, & Thompson-Schill, 2005). We tested this hypothesis with comparing individual differences in garden-path effects during sentence comprehension on the one hand and verbal and non-verbal cognitive control abilities on the other hand. If cognitive control is necessary for garden-path recovery then correlations will be found between performances on cognitive control tasks and garden path effects. Garden-path effect was measured with a self-paced reading task and we used a verbal and a non-verbal Stroop task as well as a verbal and a non-verbal interfering n-back task for assessing cognitive control abilities. We found a significant garden-path effect which correlated with none of the cognitive control measures, only with one working memory updating score of the verbal and non-verbal n-back tasks without correlating with the other WM updating scores. These results suggest that cognitive control abilities necessary for garden-path recovery differ from cognitive control abilities required for the Stroop and n-back tasks which contradicts with Novick and his colleagues' study. The lack of correlations, however, could be caused by methodological issues therefore further studies are needed to rule out this possibility.

Analyzing resting state fMRI data with elastic similarity measures

Regina Meszlényi

The standard tool of analyzing connectivity patterns of the human brain, is calculating correlation coefficients between the properly preprocessed voxelwise time-series. Due to the tremendous computation time, usually one, or a few seed voxels are selected and these voxels' signals are compared to all the remaining voxels of the gray matter. With this procedure the seed voxel's functional network can be identified.

In our study we investigated the effect of using a different similarity measure, called dynamic time warping (DTW), instead of linear correlation. To motivate this choice, the following figures illustrate the new approach's potential in comparison of time-series.
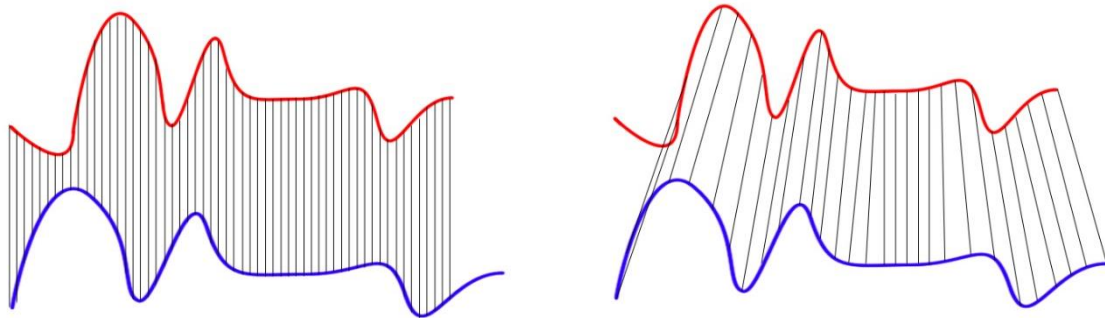
Standard matching used in correlation   Elastic matching used in DTW

As we can see on the example given above, when we calculate simple linear correlation, we always compare the i-th element of the first time series with the i-th element of the second, and this way, if the second series is out of phase, or slightly distorted, the correlation coefficient can be deceptively small. The dynamic time warping algorithm however uses elastic matching of the series' elements, which can correct for time-shifts as well as distortions of the shape of the signal.

Our hypothesis is that the application of dynamic time warping instead of correlation in identifying functional networks will result in more wide-spread connectivity patterns, since similarity measured with DTW is less dependent on the distance of the seed's and the compared voxel's location then correlation, because DTW corrects for potential time-lags and other confounding factors that are usually stronger in case of spatially distant regions.

To test our hypothesis we analyzed resting state data from a previous study (Hermann, Petra, et al. "Neural Basis of Identity Information Extraction from Noisy Face Images." *The Journal of Neuroscience* 35.18 (2015): 7165-7173.) with seed voxels from bilateral FFA and LOC. The early results indeed shows that in resting state both FFA and LOC is strongly and significantly connected to the default mode network, and several other distant areas of the brain.

Self-initiated tones: feedback to optimize tone-eliciting

Neszmélyi Bence[1,2]
Horváth János[1]

[1] Research Centre for Natural Sciences, Hungarian Academy of Sciences
[2] Budapest University of Technology and Economics

Goal-directed behavior depends on the utilization of information about future events. Such information can be represented by various cognitive subsystems, which may or may not directly interact. The present study investigated the information flow between the motor and the auditory systems. Event-related potentials (ERPs) elicited by action-sound coincidences are smaller than those elicited by sounds in the absence of action. However a valid comparison between the two conditions is only possible if motor and auditory effects can be separated in the ERPs evoked by action-effect couplings. The auditory contribution to the coincidence waveform is usually estimated by subtracting an ERP related to actions not coinciding with sounds. This logic relies

on the assumption that actions and action-related ERPs are identical in the two conditions. For paradigms with self-induced sounds, this assumption is not self-evident: the results of our experiment suggest that predictions about distal sensory consequences can influence physical parameters of actions. Participants pinched a force sensitive resistor (FSR), which triggered the presentation of a sound when the force reached a threshold (Motor-Auditory condition) or had no auditory effect (Motor condition). In the Auditory condition, a replay of a previous sound sequence was presented. Pinch-force profiles were markedly different between conditions: the applied force was stronger, and pressure was maintained for longer in the Motor-, than in the Motor-Auditory condition. Moreover systematic pinch-force changes within blocks differ in the two conditions: In the motor-auditory condition the FSR-amplitudes decreased as a function of time indicating that participants applied less and less force during the course of each block. In the motor condition the opposite tendency could be observed: within each block, the peak amplitude seemed to increase. These results suggest that participants used the self-initiated sounds as feedback to optimize the to-be executed motor patterns. It seems, that the logic behind calculating the auditory component in the action-tone ERP is flawed, as the presence of auditory feedback appeared to have considerable effect on the action parameters. Importantly however, separating the Motor ERPs by the applied force did not substantially affect the ERPs, which suggests that the observed self-initiation-related ERP attenuations are unlikely to be caused by these differences.

Dopamine improves performance after surprising events and induces psychotic-like experiences in patients with Parkinson's disease

Bertalan Polner, Helga Nagy, Annamária Takáts, Szabolcs Kéri

Dopamine neurons are sensitive to novel and rewarding events, and dopamine signals can modulate learning and memory. Additionally, dopamine abnormalities appear to be central to the pathophysiology of schizophrenia spectrum disorders. In this study, we set out to investigate the dopaminergic modulation of schizotypal traits and expectancy violation processing in Parkinson's disease (PD) patients on dopamine replacement therapy. Expectancy violation processing was measured with a latent inhibition and an anomaly categorisation task. Patients with PD had significantly elevated levels of schizotypy and reduced latent inhibition, relative to the controls. Anomaly categorisation was enhanced at trend level among the patients. Dopaminergic antiparkinsonian drugs showed dose-dependent effects: they induced psychotic-like experiences, and at the same time, they disrupted latent inhibition and made categorisation of anomaly more efficient. An up-regulated dopamine system in medicated PD patients might tune higher-level brain networks to engage in learning when faced with unexpected information, and therefore hasten updating of internal models.

Age-related loss of sleep EEG delta power is reduced in highly intelligent subjects

Adrián Pótári[5*], Péter P. Ujma[1*], Boris Nikolai Konrad[2], Péter Simor[5,8], Péter Rigó, János Körmendi[6], Ferenc Gombos[1], Axel Steiger[4], Martin Dresler[2,4], Róbert Bódizs[1,7]

[1] Institute of Behavioral Science, Semmelweis University, H-1089 Budapest, Hungary
[2] Donders Institute for Brain, Cognition and Behaviour, Radboud University Medical Centre, 6525 EN Nijmegen, The Netherlands
[4] Max Planck Institute of Psychiatry, 80804 Munich, Germany
[5] Department of Cognitive Sciences, Budapest University of Technology and Economics, H-1111 Budapest, Hungary
[6] Department of Electrical Engineering and Information Systems, Pannon University, H-8200 Veszprém, Hungary
[7] Department of General Psychology, Pázmány Péter Catholic University, H-1088 Budapest, Hungary
[8] Nyírő Gyula Hospital, National Institute of Psychiatry and Addictions, Budapest, Hungary
* Equal contribution.

Delta power in NREM sleep has been shown to reflect general and sleep-related neural plasticity, to follow a distinct postero-anterior maturational curve and to decrease with ageing, both in line with changes of human cognitive ability. Individuals with higher general intelligence (IQ) were shown to be less affected by age-related cognitive decline or other disorders and have longer lifespans. Based on previous findings between IQ and the individual sleep EEG profile, we investigated the correlation between age and EEG power in 159 healthy subjects (age range: 17-69 years) from an average (IQ<120; N = 87) and superior IQ≥120; N = 72) IQ subgroup. We found evidence for less age-related decrease in all-night relative NREM sleep EEG delta power and less age-related increase in relative EEG theta and alpha power in the superior IQ subgroup. These effects were present in the first two cycles of night sleep and disappeared thereafter. Our results suggest that high IQ individuals are less affected by the sleep-dependent effects of biological ageing, and therefore potentially less at risk for age-related cognitive deficits and other disease.

Keywords: sleep EEG, slow wave activity, delta rhythm, theta rhythm, aging

Eye-tracking and EMG supported 3D Virtual Reality – an integrated tool for perceptual and motor development of children with severe physical disabilities: a research concept

Márk Ágoston Pulay

Letting children with severe physical disabilities (like Tetraparesis Spastica) to get relevant motional experiences of appropriate quality and quantity is now the greatest challenge for us in the field of neurorehabilitation. These motional experiences may establish many cognitive processes, but may also cause additional secondary cognitive dysfunctions such as disorders in body image, figure invariance, visual perception, auditory differentiation, concentration, analytic and synthetic ways of thinking, visual memory etc. [1].

It has been recognized that the quality of life of these children can significantly be improved by the application of new technologies when they are designed and developed

considering accessibility requirements. During the past decades new Assistive Technologies (AT) applications (e.g. Virtual Environments (VE), Virtual Reality (VR), 3D Interfaces, etc.) have been developed to improve perceptual learning (visual, auditory perception) and visuo-spatial skills of children with severe physical disabilities. On the other side unfortunately, there were less evidence-based effective interventions for improving participation of these children. Perception refers to the process of taking in, organizing, and interpreting sensory information. Perception is multimodal, with multiple sensory inputs contributing to motor responses. The ability to construct or reproduce spatial relationships in two or three dimensions is named in psychology as a visuo-spatial skill. Visuo-spatial skills have historically been chosen as an essential component of psychoeducational evaluations in children. Learning basic academic skills, such as writing, reading, spelling, and math, is commonly related to visuo-spatial skills [2].

Our planned research has two main lines of bearing. One of them is the AT device adaptation and development which is the key element to make the computer accessible to the target group. Based on our own experiences and a thorough literature review we have come to the conclusion that an effective combination of eye-tracking and EMG devices should work well. The second one is the adaptation and development of 3D/VR applications to improve perceptual learning (visual, auditory perception) and visuo-spatial skills of children with severe motor disabilities.

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The characteristics of multicultural team work in light of team mental model and cognitive consensus

Veronika Takács

As one of the consequences of globalization, multicultural teams - whose members work together toward a common goal despite of their differences in nationality, language and cultural background - are becoming increasingly common. When it comes to effectiveness, it automatically raises the question of how these heterogeneous teams are able to work effectively. Up until now researchers define multiculturalism as a „double edge sword" and tend to overemphasize obstacles and problems related to the phenomenon. The main reason of this trend might derive from the fact that the majority of researches are based on the concepts of social identity and perceived similarity, leaving no or very little space for such important deep level cultural characteristics as beliefs, value systems and interpretation. Since one of the most important factors in team effectiveness is team knowledge and knowledge management, it might also be crucial to apply a theoretical framework that includes such deep level differences when it comes to exploring multicultural team processes. In the recent research project the theory of cognitive consensus is proposed as a complementation of team mental model concept, aiming for an expanded conceptual framework of multicultural team knowledge. The goal this research is to raise scientific attention of deep level cultural differences as often invisible, yet stronger predictors of team effectiveness than surface level differences among team members.

Key words: culture, multiculturalism, team work, team mental model, cognitive consensus