

# Learning & Perception

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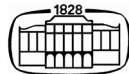
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## II. Dubrovnik Conference on Cognitive Science

DuCog II

# PERCEPTUAL LEARNING

in the framework of the **Central European Cognitive Science Association (CECOG)**

Invited talks

**Steven M. Silverstein, Ilona Kovács, Dov Sagi, József Fiser**

DUBROVNIK, 6–9 MAY 2010  
Centre for Advanced Academic Studies (CAAS) Dubrovnik  
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## PROGRAMME

### Thursday, May 6

14:00–                   Arrival  
20:00–                   Welcome reception

### Friday, May 7

8:30–9:30               Registration and Coffee  
9:30–10:00             Welcome words by *Csaba Pléh*, president of CECOG  
10:00–11:00           **Tutorial I:** *Steven M. Silverstein*: Perceptual organization impairments in schizophrenia: Bottom-up vs. top-down factors, learning, and brain mechanisms  
  
11:00–12:00           **Short talks – session 1**  
12:00–15:00           *Lunch*  
15:00–16:00           **Poster session 1**  
16:00–16:30           *Coffee*  
16:30–17:30           **Tutorial II:** *Ilona Kovács*: Sleep, the Achilles' heel of brain development?  
17:30–18:30           **Poster session 2**

### Saturday, May 8

8:30–9:30               *Coffee*  
9:30–10:30             **Poster session 3**  
10:30–11:00           *Coffee*  
11:00–12:00           **Tutorial III:** *Dov Sagi*: Perceptual over-learning  
12:00–15:00           *Lunch*  
15:00–16:00           **Poster session 4**  
16:00–16:30           *Coffee*  
16:30–17:30           **Tutorial IV:** *József Fiser*: Probabilistic learning and perception  
17:30–18:30           **Short talks – session 2**  
18:30–18:45           Farewell words by *Ilona Kovács*  
19:00–19:30           CECOG Assembly

### Sunday, May 9

8:30–9:30               *Coffee*  
9:30–12:00             Departure

## SHORT TALKS

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### Short talks – session 1: Friday, May 7, 11:00–12:00

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Chaired by *Csaba Pléh*

**Auditory perceptual learning: The rapid formation of durable memories for noise**

*Trevor Agus, Simon Thorpe, Daniel Pressnitzer*

**Phonological mediation and phonotactic repair**

*Natalia Kartushina Aleksandrovna*

**In search for the prerequisites of stable auditory object perception**

*Orsolya Szalardy, Alexandra Bendixen, Susan L. Denham, István Winkler*

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### Short talks – session 2: Saturday, May 8, 17:30–18:30

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Chaired by *Ilona Kovács*

**Ratio comparisons and the mental number line**

*David M. Gomez, Pablo Dartnell*

**Modality-independent implicit sequence learning**

*Kornél Németh, Ferenc Kemény*

**Psychological distress and individual differences influence performance on decision-making related tasks**

*Sofia Laureano-Schelten, David Hevey, Kevin Thomas*

**POSTER SESSIONS**

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**Poster session 1: Friday, May 7, 15:00–16:00**

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**Retrieval induced forgetting, task cancelation and sleep***Gyula Demeter, Mihály Racsmány, Martin A. Conway***Theory of mind development at preadolescence – Metaphors in describing human beings***Elzbieta Dryll, Ewa Marta Dryll, Aleksandra Olszanska***Episodic component in inhibition of return of attention***Attila Keresztes, Gyula Kovács, Mihály Racsmány***Object perception and memory for objects in communicative context***Hanna Marno, Eddy J. Davelaar, Gergely Csibra***Worry is associated with enhanced memory performance***Péter Pajkossy, Mihály Racsmány***Mediating variables of correlation between working memory and reading comprehension at 9–12 years***Rosana Stan***The electrophysiological correlates of directed forgetting***Brigitta Tóth, Roland Boha, Zsófia Anna Gaál, Máté Benyovszky, Márk Molnár***Face similarity – Why do we perceive two faces similar to each other?***Klára Várhelyi*

**Poster session 2: Friday, May 7, 17:30–18:30**

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**Neuropsychological examination of emotional processes***Mónika Albu, Gyurgyinka Gergev***Attentional SNARC – Categorical or linear?***Krzysztof Cipora, Dorota Żelechowska***Approach/avoidance behavior and the breadth of attention***Dominika Czajak, Dorota Żelechowska***The Simon effect for horizontal and vertical stimulus-response relations: Evidence for similar effect functions in a uni-manual dynamical response paradigm***Halil Duzcu, Özgür Erisen, Annette Hohenberger***Attention affects the formation of regularity representations: An MMN study***Gábor P. Hádén, Elyse S. Sussman, István Czigler, István Winkler***On the interaction of syntax and semantics: An ERP study***Stéphane Robert***Dreaming and affective regulation: Preliminary findings and a neurocognitive framework***Péter Simor, Szilvia Csóka, Róbert Bódizs***On the influence of affect on cognitive control***Maciej Taraday*



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**Poster session 3: Saturday, May 8, 9:30–10:30**

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**Causative motion events in sign languages***Engin Arik, Marina Milković***Emotional priming with IAPS pictures***Sanja Budimir, Marijan Palmović***From priming to aftereffects: Experience-dependent modulation in the perception of ambiguous objects***Valentina Daelli, Alessandro Treves***Development and plasticity of primary visual and motor function in humans***Patricia Gerván, Andrea Berencsi, Tamás Madarász, Ilona Kovács***Sleep macrostructure, NREM sleep EEG spectra and their correlations with perceptual learning in WS***Ferenc Gombos, Patricia Gerván, Róbert Bódizs, Ilona Kovács***Developmental dissociation between number fact memory and mathematical reasoning skills***Beth L. Losiewicz, Elena Rusconi***A connectionist simulation of impaired perceptual integration in autism***Zsombor Várnagy, Miklós Györi***Perceptual effect on motor learning in the serial reaction time task***Ferenc Kemény, Ágnes Lukács*

**Poster session 4: Saturday, May 8, 15:00–16:00**

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**Reading comprehension in bilingual schools***Ágnes Boncsér, Tünde Éva Polonyi***Language use in the sound categorization and description task***Irina Borisova***The sound-language interface: Category-external sounds inhibit the processing of concrete and abstract sound-related language relative to category-internal sounds***István Fekete, Anna Babarczy***Metaphors in conversations: A conceptual or a pragmatic trick?***Bálint Forgács***Monolingualism, bilingualism and the representation of emotional concepts***Beáta Grabovac***Eye-tracking evidence for processing quantified utterances***Gordana Hržica, Nevena Padovan, Jelena Kuvač Kraljević***Experimental evidence for vagueness***Magdalena Krbot, Ana Branka Šefer, Marijan Palmović***Aesthetic or grammatical? – The role of melodic factors in linguistic variation***Márta Peredy*

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## Abstracts – Tutorials

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### *Tutorial I*

#### **Perceptual organization impairments in schizophrenia: Bottom-up vs. top-down factors, learning, and brain mechanisms**

*Steven M. Silverstein*

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Perceptual organization is a basic process of the visual system, and is responsible for binding related features into coherent representations. However, in certain brain diseases, this process can become less efficient (Silverstein, in press). One such condition is schizophrenia, where over 25 studies have now demonstrated reduced perceptual organization (Uhlhaas & Silverstein, 2005). Moreover, in schizophrenia, this impairment appears to be one aspect of a more general disturbance in coordinating components of mental representations, which is observed in other sensory domains and in language production as well (Phillips & Silverstein, 2003). Impaired perceptual organization also appears to define a subtype of patient who is characterized by a history of poor social and academic functioning prior to the illness, less responsiveness to treatment, and greater disorganization of speech and behavior (Knight & Silverstein, 1998). Finally, this disturbance occurs not only on laboratory tasks, but in the phenomenological reports of patient experiences (Carr & Wale, 1986). This talk will review clinical and laboratory manifestations of perceptual organization disturbance, and then focus on questions central to better understanding perceptual organization impairment in schizophrenia, as well as its modifiability, as a means to better understanding the process in people without illness.

First, clinical manifestations of visual perceptual organization will be described, followed by examples of what appear to be analogous forms of reduced organization in other cognitive domains. A key question here is – are these similarities meaningful, and do they imply that all of these disturbances reflect a more basic process rooted in abnormal neural circuitry?

Second, laboratory examples of perceptual organization impairment will be described. Tasks will be chosen that, in most cases, have been investigated along with functional magnetic resonance imaging (fMRI) (e.g., Silverstein et al., 2009, in press) or electroencephalography (EEG) (Uhlhaas et al., 2006a), which can help localize the brain regions, and define the connectivity issues, associated with abnormal task performance. A key question here is – what do abnormal activation in multiple brain regions (e.g., occipital, frontal, and subcortical areas) and reduced gamma- and beta-band synchrony in people with schizophrenia during task performance indicate about how perceptual organization is implemented in the normal brain?

The next, and third, section of the talk will cover evidence that perceptual organization impairment in schizophrenia involves reduced top-down input to perceptual processes. While this is suggested by fMRI data, experimental psychophysical data will be presented that bear directly on this issue. Effects of stimulus repetition (Silverstein et al., 2005), gradual versus random changes in difficulty level (Silverstein et al., 2006), and prior success (Silverstein et al., unpublished data) will be reviewed. Data on changes in performance across multiple days will also be presented (Silverstein et al., 2006). Key questions here are – what does this evidence indicate about relationships between perception, expectation, experience, memory, and learning, and what does this evidence imply for improving perceptual organization in schizophrenia. For example, what should such an intervention look like? Would it be fo-

cused on strengthening bottom-up and/or top-down processes? Would it focus on perceptual and/or conceptual skills?

The fourth section of the talk will review clinical correlates of perceptual organization impairment, including premorbid social functioning, face perception, symptoms, recovery rate, theory of mind ability, and nailfold plexus visibility (Schenkel et al., 2005; Uhlhaas et al., 2006b; Silverstein et al., 1998, in press). This will raise the issue of the functional consequences of reduced stimulus organization and reduced top-down modulation of sensory and perceptual experience. In addition, differences in integrity of perceptual organization between people at risk for schizophrenia, people during their first psychotic episode, and people with chronic illness will be reviewed (Parnas et al., 2001; Silverstein et al., 1992, 1996, 2006; Uhlhaas et al., 2004). Effects of treatment on perceptual organization will also be described (Uhlhaas et al., 2005). A key question here is – what do the data on changes in perceptual organization with illness severity and chronicity, and with treatment, indicate about the relationships between the impairment and overall functioning? Related questions are – does perceptual organization ability vary significantly in the “neurotypical” population, and if so, is it related to aspects of functioning, can it be improved, and if it is improved what might be the expected consequences?

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*Tutorial II***Sleep, the Achilles' heel of brain development?***Ilona Kovács*HAS–BME Cognitive Science Research Group, Budapest, Hungary  
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Among the chief causes of mental retardation (or, with a more p.c. term: developmental disability) are genetic conditions, prenatal or perinatal injuries, diseases, poverty and cultural deprivation. Research has been mainly focused on attacking each of these factors separately, characterizing how they might determine different types of maladaptive behaviors. In this talk, I will investigate the possibility that the disturbance of the macro- and/or the micropattern of sleep is a more general factor. I suggest that sleep, the Achilles' heel of brain development, might shape the individual's ability to improve basic procedural (perceptual and motor) skills in order to compensate for the above mentioned handicaps. This hypothesis will be supported by examples from our developmental and clinical studies.

Procedural learning consists of a broad range of motor and perceptual skills. In order to build up an experimental framework within which to study the impact of sleep on procedural learning, we first obtained perceptual and motor learning curves in neurotypically developing subjects (see abstract by Gerván, Berencsi and Kovács in this issue). We employed a behavioral contour integration paradigm (CI), designed to test occipital visual function, and a finger tapping (FT) paradigm to test primary motor cortex function. Sleep-dependent learning has been demonstrated previously in both tasks (Gervan and Kovacs, 2010; Karni et al., 1994; Walker et al., 2003). Initial performance in CI and FT increased with age, showing a prolonged maturation of visual spatial integration and fine motor coordination, without reaching a plateau at 25 years of age. Practice induced performance improvement was obvious in all age-groups, with the younger groups showing faster improvement and a greater capacity to learn. These data confirm that low-level visual and motor cortices develop at similar rates, and preserve their plasticity into adulthood, and, at the same time, provide us with standardized data for further clinical studies.

Williams syndrome (WS) is a neurodevelopmental disorder with a very specific genetic abnormality, intriguing cognitive profile, and surprisingly large neurobehavioral differences among WS individuals. Neurogenetic developmental disorders have generated considerable excitement in terms of linking genes to brain and behavior during the past decade (see e.g., Campbell et al., 2009; Dai et al., 2009; Walter et al., 2009). There is a hope that behavioral neurogenetic studies will elucidate the determinants of developmental trajectories, and also lead to more optimal interventions and treatments. However, individuals in these atypically developing populations cannot be treated as a homogenous group of subjects. In order to understand the role of genes controlling neurodevelopment, individual variations in the amount of genetic deletion, cortical structural abnormalities, and epigenetic factors have to be taken into account. In our studies, we employ a novel approach for dissociating structural abnormalities and certain epigenetic factors in WS individuals. Structural abnormalities in the brains of WS individuals include a relatively large loss of occipital gray matter volume (Reiss et al., 2004). This abnormality is not typically found in other neurogenetic disorders. Employing the CI task, we find that WS individuals perform much poorer than IQ and age matched Down syndrome individuals. This is in general agreement with the structural findings, however, there are large individual variations. Among the many epigenetic factors affecting neurodevelopment, the micropattern of sleep is known to affect performance improvement in CI. We use our database of behavioral performance of neurotypical subjects to individually match patient data and to control populations, and to predict whether a certain individual has severe occipital volumetric loss, severe sleep disturbance, or both. A similar procedure and analysis has also been performed within the FT paradigm.

Our WS subjects also underwent two consecutive full-night home polysomnography (see abstract by Gombos et al. in this issue). We analyzed sleep macrostructure and power spectra in specific EEG frequency bands at different scalp locations by using a mixed-radix FFT algorithm. Visually guided automatic scoring of leg movements (LM) was performed as well. WS subjects' sleep was characterized by decreases in total sleep time, sleep efficiency, REM duration and percent, as well as increases in time spent awake, the NREM and slow wave sleep (SWS) percent. Frequent aperiodic leg movements, largely in NREM sleep, were also observed. Although different measures of sleep macrostructure or leg movements during sleep might be useful biomarkers of disease, they do not appear to be strong predictors of the ability to learn in CI or FT. NREM sleep EEG spectra, however, seem to have significant predictive power in both visual and motor learning. This relationship between the altered sleep EEG pattern and learning in WS subjects might reveal an important link towards the genetic determination of sleep-dependent learning.

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***Tutorial III*****Perceptual over-learning***Dov Sagi*

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Performance on a variety of perceptual tasks improves with practice. The phenomenon extends to simple visual tasks, such as orientation discrimination, Vernier acuity and texture discrimination. Learning was found to be specific to basic image features, such as orientation, spatial-frequency (Fiorentini & Berardi, 1981), target location and eye of stimulation (Karni & Sagi, 1991). The high feature-specificity of learning was taken to predict that learning takes place at relatively low-level cortical areas (Fahle, 2005). The task-dependency of learning was taken to indicate that learning is controlled (gated) by high-level cortical areas (Ahissar & Hochstein, 1993). Electrophysiological studies point to neural correlates of perceptual learning in the primary visual cortex of the monkey (Gilbert et al., 2009). Studies combining perceptual learning methods and fMRI (Schwartz et al., 2002) or VEP recordings (Censor et al., 2009) in humans show that activity in the primary visual cortex correlates with plasticity in the human visual system. Some perceptual learning effects persist through life time without further practice. In the case of texture discrimination the performance improvement obtained within a few days (5–10) was preserved after 3 years (Karni & Sagi, 1993). Sleep was found to be important for the long-term consolidation of learning (Karni et al., 2004; Stickgold et al., 2000). Overall, the experimental results accumulated during the last two decades support the view that sensory regions in the adult cortex, including the primary visual cortex, are modifiable through the whole life span. Massive functional remapping seems to take place within the visual cortex of humans when the input from a region of the visual field is disrupted due to scotoma (Casco et al., 2003). More surprisingly, recent evidence show that the primary visual cortex of the congenitally blind is activated in verbal memory tasks (Amedi et al., 2003). Perceptual learning was shown to improve vision in humans with amblyopia, a developmental disorder, thus supporting the view that at least some perceptual learning effects reflect an extension into adulthood of the developmental critical period that was thought to be limited to young age (Levi & Li, 2009; Polat et al., 2004). This also suggests that perceptual learning operates on elementary functions within the visual system that developed to subservise normal vision, thus the “logic” of perceptual learning is expected to be tightly linked to that of the visual system.

Recent studies show perceptual deterioration when a task is over practiced, that is, when the number of trials is increased within a training session or between closely spaced sessions (Mednick et al., 2002, 2005; Censor et al., 2006). Experiments with texture discrimination show that these two processes inversely affect each other: decremental effects interfere with further learning, while efficient short practice results in a long-term learning effect in which performance decrements are practically eliminated (Censor & Sagi, 2008, 2009). Further results show that sleep is necessary to preserve learning effects following short training and facilitates the decay of deterioration that normally results from extensive training.

A theoretical link between perceptual deterioration and learning is suggested, assuming a system with saturating connectivity, in which continuous learning leads to saturation unless connectivity is efficiently consolidated. Thus, best learning is achieved with short training sessions. Resistance to saturation is achieved by sleep-dependent consolidation of unsaturated connectivity. The different transfer properties of the performance decrements and increments allow us to identify local and global components of perceptual learning and their interactions. This suggests sleep-dependent consolidation mechanisms that induce modifications in higher brain areas that interact with local early visual networks to enable improvement of perceptual abilities.



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***Tutorial IV*****Probabilistic learning and perception***József Fiser*

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In this talk, I will describe the observational a.k.a. statistical learning paradigm that can be used to study the kind of learning that underlies animals' and humans' ability to develop useful internal representations in order to interpret and act in their environment (Fiser, 2009). In statistical learning, a mini-world is created from an inventory of building chunks, and the subject is exposed to a large number of scenes from this mini-world without any instruction or explanation as to what to do or what to pay attention to. The subjects automatically and implicitly develop internal representations of their sensory experience that can be assessed by post-training tests probing the subjects' sense of familiarity with experienced and not experienced fragments of the mini-world. I will present a number of results in such a statistical learning paradigm that map out the basic characteristics of this kind of learning in adults and infants within the visual domain (Fiser & Aslin, 2001, 2002a, 2002b, 2005). Next, I will turn to the computational basis of such learning using a framework emerged recently in the literature that handles human perception as a statistical inference based on noisy and ambiguous sensory inputs (Chater, Tenenbaum & Yuille, 2006). After briefly demonstrating the main features of the framework in perception, I will argue that in such a framework inference (i.e. perception) and learning cannot be separated but instead they need to be handled jointly (Fiser, Berkes, Orbán & Lengyel, 2010). Next, I will show that human visual statistical learning can be captured by a probabilistic learning model better than earlier models based on frequencies, relative frequencies or recursive pair-wise Hebbian associative learning rules (Orbán, Fiser, Aslin & Lengyel, 2008). I will demonstrate how such a framework gives a natural reconciliation between the two sides of the ongoing debate whether learning statistical regularities based on visible elements and learning successfully abstract rules involve two separate learning mechanisms (Marcus, Vijayan, Bandi Rao & Vishton, 1999). I will argue that under the probabilistic approach the transition from one to the other naturally follows, and I will show a number of results that co-investigate statistical and rule learning in the environment where they both exist. Since memory is inevitably linked to consolidation, I will present some data on how these types of learning benefit from longer consolidation process and sleep. In the final part of my talk, I will turn to implementational questions, namely the issue of what neural representations in the cortex would be suitable for carrying out such probabilistic computations that execute statistical learning. Probabilistic neural representations have been explored before in the context of inference making in the cortex resulting in the computational framework called Probabilistic Population Codes (Ma, Beck, Latham & Pouget, 2006; Zemel, Dayan & Pouget, 1998). However, PPCs have various challenges, among them the fact that they are not well suited for executing learning. I will present an alternative framework we developed based on the "sampling hypothesis" (Hoyer & Hyvarinen, 2003; Lee & Mumford, 2003), according to which the sensory cortex represents probability distributions as a series of samples of this distribution (Fiser et al., 2010). This framework has clearly testable predictions regarding the functional role of spontaneous activity and its relation to stimulus evoked activity in biological networks. The framework is also supported by previous results showing strong presence of spontaneous activity in the cortex as well and by the similarity of the spatio-temporal structure between this spontaneous activity and activity evoked by natural sensory stimulation (Fiser, Chiu & Weliky, 2004; Raichle et al., 2001; Tsodyks, Kenet, Grinvald & Arieli, 1999). Finally, I show some new evidence that confirms some of the above mentioned predictions about the link between spontaneous and visually evoked activities (Berkes, Orbán, Lengyel & Fiser, 2009).

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## Abstracts – Short talks

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### Auditory perceptual learning: The rapid formation of durable memories for noise

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Before a natural sound can be recognised, an auditory signature of its source must be learnt through experience. Here we used random waveforms to probe the formation of new memories for arbitrary complex sounds. The behavioral measure was based on the detection of repetitions embedded in 1s-long noises. Unbeknownst to the listeners, some noise samples re-occurred randomly throughout an experimental block. In line with our hypothesis, repetitions in these re-occurring noises were better detected, showing that repeated exposure could induce learning of otherwise meaningless sounds. The learning displayed several important features: (1) it was unsupervised, (2) it was resilient to interference from other task-relevant noises, (3) it emerged rapidly, and (4) after learning, performance was near-perfect. Furthermore, a follow-up experiment showed that multiple noises were remembered over many days. Such fast, durable learning resembles “perceptual insight”. A third and fourth experiment investigated the memories’ acoustical substrates: frequency-shifted versions of learnt noises were also recognised, but only for small frequency shifts (less than half an octave), but learning transferred near-perfectly to reversed noises. We propose that rapid sensory plasticity combined with top-down feature selection could describe how the auditory brain creates memories from the ever-changing, but sometimes repeating, acoustical world.

**Keywords:** hearing, perceptual insight, long-term memory, implicit learning, plasticity

### Phonological mediation and phonotactic repair

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The perception of non native sounds is biased by the phonological system of native language which acts as a phonological filter. In on-line perception tasks French listeners strongly tend to hear illegal-initial utterance [tla] as /kla/. This phonological repair mechanism is directly translated in the visual modality: the printed pseudoword “tlavier” activates phonological code /tlavier/ which is repaired in “clavier”.

Our study tests this “phonological repair” hypothesis using the visual masked priming paradigm. The primes were derived from /kl/ initial words by substitution of the first phoneme. We demonstrated, via lexical decision task, the greater efficacy (20 ms) of “tlavier” than “plavier” in priming “clavier”. This effect of facilitation is robust for two SOA examined (100 and 150 ms). We propose that two types of primes generate different phonological codes: “tl” activates /tl/ which is illegal, thus repaired in /kl/, whereas “pl” activates /pl/ legal, which has no need to be repaired.

Our results suggest that phonological overlap with target “clavier” /klavje/ is more important for “tlavier” /tlavje/ than “plavier” /plavje/. The transgression of “tl” in visual presentation follows the same pattern of phonological repair as in on-line perception: /tl/?/kl/ substitution.

**Keywords:** phonological repair, phonotactics, perception of illegal clusters, visual masked priming paradigm, phonological code

### **In search for the prerequisites of stable auditory object perception**

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In the acoustic world surrounding us, sounds emitted by different sources interfere with each other before arriving to the ears. A key function of the auditory system is to provide us with consistent information about the identity and location of sound sources (objects). This function is termed auditory stream segregation. A sequence of alternating high and low tones can be perceived as either one or two streams. Integrating the sounds into one stream suggests a single source, whereas segregating the sounds to two streams suggests two sources. The integrated and segregated interpretations of the sound sequence compete with each other, switching back and forth between the two alternatives. However, in everyday situations, we do not experience switching between alternative interpretations. Our experiments were aimed at discovering the prerequisites of stable stream/object perception. We tested the effects of different stream segregation cues on the stability of stream segregation. Primitive cues, such as location, frequency and amplitude modulation difference facilitate segregation, but they do not completely stabilize the streams. Higher order cues, such as separate within stream temporal regularities may account for the stability of perception. The presentation will summarize the results obtained in a series of perceptual experiments.

**Keywords:** auditory streaming, perceptual bi-stability, auditory scene analysis, perceptual switching

### **Ratio comparisons and the mental number line**

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A growing body of evidence supports the idea that whole number representations depend on a logarithmically scaled mental number line. Such a compression pattern accounts very well for the fact that perceptual distance between two integer numerosities is better described by their ratio than by their difference. Believing that a truly logarithmic scale would host ratios in the same mental number line than integer numerosities, we investigated the properties of these ratio representations. Adult participants performed a visual ratio comparison task, choosing the greater red-to-blue or blue-to-red ratio between two sets containing red and blue dots. As expected, accuracy ratios were higher as the distance between ratios increased. Moreover, ratio-based distance provided a better model than absolute distance just as it does for integer comparisons. A new group of participants performed a similar task, choosing the greater red-to-blue or blue-to-red ratio between two rectangles whose sides were red and blue bars. The results replicated those of the first experiment, showing that these ratio representations are independent of the presentation format. Thus, comparison of ratio representations is also grounded on a ratio-based perceptual distance. This finding is compatible with the hypothesis that the mental number line also houses representations for rational numbers.

**Keywords:** psychomathematics, number sense, proportions, ratio comparison, mental number line, numerical cognition

### **Modality-independent implicit sequence learning**

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There are three main ways to interpret sequence-specific learning: effector-based (an effector – e. g. finger – learns the sequence), response-based (motor learning), and perceptual-based (learning the sequence of target locations). These approaches build on discrete forms of learning and thus exclude the possibility of an abstract, modality-independent sequence representation. Our study tested the hypothesis that during sequence learning, modality-independent representations might form. We used a version of the SRT task (Serial Reaction-Time Task), in which targets (nonsense syllables) were presented auditorily. In condition 1 participants first observed a visual sequence, which was congruent with the sequence in the following auditory SRT task. In condition 2 the visual and auditory sequences were incongruent, and in control condition 3 participants only completed the auditory SRT task. A previously observed congruent visual sequence facilitated sequence-learning, while in the incongruent condition there was no such effect. Without pre-training (condition 3) reaction times at the beginning of the task were longer than those in condition 1, but the difference disappeared by the end of the task. We hypothesize that the visual sequence established a modality-independent representation, which facilitated the acquisition of a congruent sequence and interfered with the acquisition of an incongruent one in another modality.

**Keywords:** implicit sequence learning, SRT, modality-independent representation, transfer effect

### **Psychological distress and individual differences influence performance on decision-making related tasks**

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Recent research has focused on the role of emotion in decision-making. This study sought to examine whether individual differences in various cognitive and emotional processes predict decision-making task performance. Thirty participants (15 male; mean age = 36.0, SD = 15.7) completed the Iowa Gambling Task (IGT), Ultimatum Game (UG), Balloon Analogue Risk Task (BART), and the following questionnaires: Beck Depression Inventory (BDI), Need for Cognition (NFC), Need for Affect (NAQ), Behavioural Inhibition Scale (BIS) and Behavioural Activation Scale (BAS). Although participants generally demonstrated learning over time ( $F(4,116) = 17.12, p < .001$ ), with differences ( $p < .005$ ) between scores on Block 1 and the other Blocks, 20% scored in the impaired range (IGT net score  $< 10$ ) on the IGT. Participants within the clinical range on the BDI were poorer on the IGT ( $p < .05$ ) than those not in this range. The NAQ was ( $p < .05$ ) associated with performance on the BART ( $r = .38$ ) and the IGT ( $r = .49$ ). Also, performance on the UG correlated ( $p < .05$ ) with the BIS punishment sensitivity scale ( $r = .41$ ) and the BAS drive scale ( $r = .37$ ). Psychological distress was associated with poorer decision-making on the IGT. Furthermore, individual difference variables were related to decision-making task performance. The study provides further evidence of the role of affect and individual differences in decision-making.

**Keywords:** decision-making, risk-taking, economic games, emotion, individual differences

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## Abstracts – Posters

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### Neuropsychological examination of emotional processes

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The main purpose of this lesion study was to examine the separate role of the brain's two hemispheres in various emotional processes. Four main hypotheses have been put forth to explain the role of the two hemispheres in emotional processes: the "right-hemisphere" hypothesis, the "emotional value" hypothesis, the "type of the emotion" hypothesis and the "somatic-marker" hypothesis. We developed a new emotional test: The Emotional and Social Competences Test. This test has seven subtests measuring verbal and nonverbal basic emotions, complex emotions, body language, comprehension of social situations, emotional analogies, empathy and reading in the mind ability. Anterior and posterior area injured patients with left- or right-sided lesions were included in this study. Patients with right-sided lesion had a more affected performance in all but one of the subtests in comparison with patients with left hemisphere lesion. Right frontal lobe injured patients showed the most severe disabilities in the comprehension of emotions.

Conclusions: The results support the assumption that the "right hemisphere" hypothesis combined with the "somatic-marker" hypothesis are the most appropriate ones in explaining the effect of brain injuries on emotional and social competences.

**Keywords:** lateralization, emotional processes, somatic-marker hypothesis, empathy, reading in the mind

### Causative motion events in sign languages

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Spoken languages use morphological constructions to encode spatial relations whereas sign languages (SL) use the hands and the signing space, the space in front of the body. Also, signers use classifiers in which the positioning and the movement of the two hands depict the spatial relation. While spoken languages use verbal constructions (crash, hit, cause/make +V) to encode causative motion events, it is relatively unknown how sign languages construct such relations. Pursuing this question, we investigated the descriptions of causative events in Turkish and Croatian SLs (TID and HZJ). Eight TID and eight HZJ signers (native and born to deaf families) participated in this study. They described eight short movies in which three causative events (cause to move, move together, hit each other) were created on the lateral and sagittal axes. We found that the TID and HZJ signers used the signing space and classifiers to construct causative motion events. Using different sets of classifiers, the TID signers described the causative events from their own perspective or perspective-free; whereas, the HZJ signers described them from their own perspective only. Also, contact information was not linguistically obligatory in TID or HZJ, suggesting that causation may be inferred in SLs.

**Keywords:** sign language, causative events, spatial relations, morphology

### Reading comprehension in bilingual schools

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Previous research have shown that bilingualism is associated with more effective cognitive processes (Bialystok, E., 2001). Similar results have been found in case of students attending Hungarian–English bilingual education (Cs. Czachesz – Vidákovich, 2003). The present research attempted to determine whether bilingual education and other factors have effect on the development of native language (reading comprehension). In our study we compared the performance of bilingual and "normal" grammar school students on an intelligence test, on reading comprehension and the educational level of their parents. In all cases the bilingual participants reached higher points, but these differences were not significant in either classes. Our conclusion is that bilingual education, compared to "normal" education in secondary school has a greater positive effect on the development of native language in certain cases.

**Keywords:** psycholinguistics, bilingual education, reading comprehension, intelligence, educational level of parents

### Language use in the sound categorization and description task

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This study aimed to explore the structural and semantic processes related to the categorization of sounds with a particular focus on the language descriptions given within human sound processing. Twenty sound clips from Marcell's sound collection were selected, at least three sounds from six categories (Animals, Human, Water, Mechanics, Warning, Action/Process), and randomly presented. Each sound lasted less than five seconds. The participants (native speakers of Russian, aged 24–57) were asked to listen to the sounds and to organize them in the groups whichever seem to be relevant. Then they were asked to label each group and to describe it shortly. The following analysis was threefold: sound pairs frequency, lexical and discourse analyses. The collected sound descriptions have a high type-token ratio (0.44). We observed six possible types of the sound descriptions: meta-answers that aim to describe the process of definition; descriptions of an origin; descriptions of a source; descriptions of relation; nominations; "story": metaphorical interpretations and narrations of a sound. The effect of narration was reached by describing the sounds in a temporal or in a spatial sequence or by presenting a static scene. Often these descriptions are grounded on cultural, literal and linguistic metaphors.

**Keywords:** auditory perception, sound categorization, sound description, cognitive linguistics, cognition



**Emotional priming with IAPS pictures***Sanja Budimir, Marijan Palmović*University of Zagreb, Croatia  
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Differences in processing pleasant, unpleasant and neutral emotional stimuli were detected with different methods but with no consistent results due to usage of different methodology, type of stimuli and participants. In this research we conducted a reaction time study with emotional pictures from The International Affective Picture System (IAPS). Pictures are divided in three categories; valence, arousal and dominance. In order to detect differences in reaction time for pictures with different valence (pleasant, neutral, unpleasant), a reaction time experiment was conducted with 180 emotional pictures divided into three categories by valence. Arousal and dominance were equalized for all three different valence groups. Average arousal value for all pictures is 4.83 and average dominance value is 4.99 on a scale from 1 to 9. We used emotional priming in presenting pictures, randomized within every valence category. Prime pictures were presented for 100 ms and target pictures for 1000 ms with 500 ms breaks in between. Participants needed to answer if they found target pictures pleasant or not. Differences in reaction time between emotional pictures with different valence values in regard to priming pictures were analyzed.

**Keywords:** IAPS, RT, emotions, valence

**Attentional SNARC – Categorical or linear?***Krzysztof Cipora, Dorota Żelechowska*Institute of Psychology, Jagiellonian University, Cracow, Poland  
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Presentation of small-magnitude digit causes covert shift of attention to the left, whereas large-magnitude digit causes shift of attention to the right side – Attentional SNARC. Shift of attention emerges as reduction in RTs to subsequently presented visual stimuli situated on the congruent side (compared to RTs to the stimuli on the incongruent one). Preliminary research, which aim was to investigate spatial distribution of the covert shift of attention failed to replicate attentional SNARC. Another experiment was conducted ( $n = 30$ ) to check if small or big digits (1 and 9) cause bigger (measured in physical distance) shift of attention than digits from the middle of the 1–9 distance (3 and 7). 4 possible locations of the stimulus were used. No interaction Prime\*Target Location was found. A significant effect of target location was found with shortest RTs for location close to the middle of the screen on the right. It is similar to the pseudoneglect phenomenon. Results are consistent with the conclusions from literature that attentional SNARC can be eliminated very easily by changing possible locations of stimuli. Another study was run to replicate the basic attentional SNARC effect (with primes 1, 2, 8, 9 and two “classical” target locations). Data is currently being analyzed ( $N = 20$ ).

**Keywords:** attention, attentional SNARC, covert shift of attention, number cognition, endogenous orienting of attention

**Approach/avoidance behavior and the breadth of attention***Dominika Czajak, Dorota Żelechowska*

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The aim of the study was to investigate the influence of approach and avoidance motivation (evoked by particular bodily states) on the breadth of attentional scope. It was hypothesized that enactment of approach behavior (induced by arm flexion) would broaden, whereas enactment of avoidance behavior (induced by arm extension) would narrow attentional scope. Both conditions were also compared with neutral condition (with no additional action). Under these conditions subjects ( $N = 34$ ) performed attentional task – they had to respond to the dot appearing in one of the 5 positions on the screen (one central and four peripheral, situated on the horizontal line). Results indicate that despite the condition, attention was focused upon peripheral, but not central part of visual field. Longer RTs for the central dot position can be caused by an inhibition of return (IOR) effect, evoked by the centrally situated fixation cross, disappearing before the exposition of the dot. This explanation seems to be consistent with previous research – in similar task, without fixation point, no differences between RTs for particular dot positions were observed. Further study exploring occurrence of this effect is being conducted. During attentional task another type of fixation point is used.

**Keywords:** attention, motivation, approach/avoidance, embodiment, inhibition of return

**From priming to aftereffects: Experience-dependent modulation in the perception of ambiguous objects***Valentina Daelli, Alessandro Treves*

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Recent perceptual experience can strongly influence the way in which ambiguous stimuli are interpreted and categorized. A well known example is the phenomenon of adaptation aftereffects, that occurs when prolonged exposure to an image induces a repulsive bias in the perception of a subsequently presented ambiguous stimulus. On certain conditions, however, the first stimulus can induce a facilitatory, attractive effect on the recognition of the ambiguous image (priming effect). Studies on motion aftereffects have found that both repulsive (adaptation aftereffects) and attractive effects (priming) can be observed in the perception of motion, depending on the nature of the adapting stimulus: whereas an unambiguous adapter induced a repulsive effect, when the adapter was ambiguous perception was attracted towards the adapter in a priming-like fashion. Studies on high-level aftereffects, however, have not explored the role of the ambiguity of the adapting stimulus. In this study we used morphed complex stimuli and we investigated whether ambiguous and unambiguous adapters can induce opposite effects in the perception of ambiguous stimuli. We have found that the direction of the observed perceptual bias depends on the nature of the adapter: a repulsive effect is observed with unambiguous ones, whereas ambiguous adapters induce a priming effect.

**Keywords:** adaptation aftereffects, priming, ambiguous stimuli

**Retrieval induced forgetting, task cancelation and sleep***Gyula Demeter<sup>1</sup>, Mihály Racsmány<sup>1,2</sup>, Martin A. Conway<sup>3</sup>*<sup>1</sup>Budapest University of Technology and Economics, Hungary<sup>2</sup>Institute of Psychology, University of Szeged, Hungary<sup>3</sup>The Leeds Memory Group, Institute of Psychological Sciences, University of Leeds, UK  
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Consolidation processes operating during a nocturnal sleep cycle should influence the retention of recently formed episodic memories, and we explored this idea in three experiments using the retrieval-practice procedure. In the retrieval practice procedure selected items from a previously studied list are repeatedly recalled. The effect is considerably enhanced memory for practiced items with low levels of recall, relative to baseline, for previously studied items associated with the practiced items but which were not themselves practiced. These effects were found to persist over a 12h retention interval if the items were maintained in memory by frequent rehearsal or if a period of nocturnal sleep occurred during the retention interval. When rehearsal was reduced or did not occur, long-term retrieval practice effects were only present following a full period of sleep. It is proposed that consolidation processes occurring during sleep, possibly featuring off-line elaborative rehearsal, mediate this long-term effect of retrieval practice.

**Keywords:** retrieval practice, episodic memory, sleep, consolidation, rehearsal

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**Theory of mind development at preadolescence –  
Metaphors in describing human beings***Elzbieta Dryll, Ewa Marta Dryll, Aleksandra Olszanska*

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The significance of understanding the problem of ‘theory of mind’ is strongly supported by the amount of empirical research done in this area over the last 30 years. Although it can be assumed, on the basis of previous studies, that ToM is significantly changing throughout the lifetime, there is still little research concerned with children older than preschoolers. The reported exploratory study is trying to examine how ToM develops in preadolescence and what kinds of specific cognitive abilities it consists of. We primarily aimed to find out when the ability to understand non-literal descriptions of human beings begins to develop. Methodology used in the study follows the ideas of the grounded theory, so the conclusions are derived straight from empirical data. We created a new tool – a number of metaphors describing a person, all taken from the domain of animals and divided into two groups: more or less common (pilot study). The results show, that when solving an ambiguous problem, the older the children, the more focused they are on the object’s psychological traits and the less on the features of its appearance. Because of the exploratory character of the reported study, the results need to be confirmed.

**Keywords:** theory of mind, ToM, preadolescence, ToM development, cognitive abilities, metaphor

**The Simon effect for horizontal and vertical stimulus-response relations:  
Evidence for similar effect functions in a uni-manual dynamical response paradigm**

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According to the dual-process account, horizontal and vertical Simon tasks evoke a visuomotor and a cognitive Simon effect, respectively. Due to correspondence between stimulus location and spatial anatomical status of the two hands in the horizontal task, a visuomotor Simon effect occurs with a decreasing effect function, i.e., the Simon-effect decreases with increasing reaction times. The lack of spatial anatomical symmetry leads to a cognitive Simon-effect with a stable effect function, however. Four experiments were run on a novel response board to reveal the effects of task dimension (horizontal/vertical) and task type (dynamic uni-manual /static bi-manual responses). In the dynamic paradigm, a middle key was always used to initiate a trial which helps preventing any persistent effect of the previous trial. Increased distance between the two response keys led to a right-skewed (longer) RT distribution facilitating interpretation of effect functions. We found almost the same pattern of effect size for both uni/bi-manual horizontal and uni-manual vertical tasks, namely a steady decrease in effect size, which is unexpected by the dual-process account. As we obtained similar decrements of effect size with increasing RTs, our results might be taken as support for a more cognitive account in terms of response discrimination.

**Keywords:** Simon Task, dual-process account, horizontal-vertical S-R arrangements, effect function, spatial anatomical symmetry

**The sound-language interface: Category-external sounds inhibit the processing  
of concrete and abstract sound-related language relative to category-internal sounds**

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Modality-specific theories of cognition propose that the processing of sound-related language recruits auditory imagery. The goal of the present study was to assess the automatic nature of this phenomenon. Specifically, we used the self-paced reading paradigm with specific sounds presented at the end of sound-related sentences to see whether sound representations interact with linguistic processing. Participants read five-word Hungarian sentences ending in a verb describing a sound in a concrete or a metaphorical context. In synchrony with the last word a sound was presented and played until the participant finished reading the sentence. We measured reading times on this region. The data reveal that there is a transfer from specific sounds to the processing of both concrete (e.g., The boy rang the bell) and abstract (e.g., The press rang alarm bells) sentences. Category-external sounds inhibit linguistic processing relative to both congruent and incongruent sounds and also relative to the baseline no-sound condition. Results suggest that congruent or incongruent sounds are both compatible with linguistic processing in a spreading activation manner in a semantic network where congruent nodes rapidly spread activation to incongruent nodes. Specific sound representations are not automatically accessed during this (shallow) process judging by the lack of congruency effect.

**Keywords:** sounds, sentence processing, metaphor, modality-specific

### Metaphors in conversations: A conceptual or a pragmatic trick?

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There is little evidence supporting the claim of the cognitive metaphor theory, that the conceptual system is metaphorical in nature. A series of experiments showed conventional metaphoric expressions processed unexpectedly in the left, and only novel metaphoric expressions in the right hemisphere. The explanation is the coarse semantic coding hypothesis: only the right hemisphere can integrate distant meanings.

In our study the aim was to test whether metaphoricity per se, or the distance of meaning is processed by the hemispheres. Five categories (conventional and novel metaphoric, closely and distantly related literal and unrelated expressions) of adjective–noun word pairs were presented, either to the left or to the right hemisphere, in a divided visual field paradigm. Preliminary results showed no significant hemispherical differences concerning the speed and the accuracy of processing. However, the tendencies indicated that even distantly related literal expressions are processed faster and more accurately by the left hemisphere. If these data are confirmed, it raises the possibility that previous results were artefacts, and/or that metaphor processing is not the integration of two distant meanings or knowledge domains. Relevance theory could provide a better explanation for metaphors: they are examples of loose language use, being ornaments of speech.

**Keywords:** metaphor, literal, coarse semantic coding, divided visual field, right hemisphere, figurative language

### Development and plasticity of primary visual and motor function in humans

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Procedural learning consists of a broad range of motor, perceptual, and cognitive skills. Our aim was to compare two domains of procedural learning from a developmental point of view. Typically developing children and adults (6–25 years) practiced for five consecutive days in visual and motor tasks that are generally used to address the lowest cortical levels of processing. As a perceptual task, we applied a contour integration paradigm, where stimuli are composed of collinear chains of Gabor elements forming an egg shaped target against a noise background. Increasing orientation jitter of the elements was introduced along the contour, and practice induced changes in perceptual threshold (PT) were measured in terms of this jitter. As a motor task we used a finger tapping paradigm, where a four-element-sequence of finger movements is executed as fast and as correctly as possible. Motor performance was monitored both in terms of accuracy and speed using a combined measure of performance rate (PR). In order to compare the two domains, normalized PT and PR values were plotted as a function of age and practice days. The data revealed that initial performance increases with age, showing a prolonged maturation of visual spatial integration and fine motor coordination, without reaching a plateau at 25 years of age. Practice induced performance improvement was obvious in all age-groups, with the younger groups showing faster improvement and a greater capacity to learn. We conclude that low-level visual and motor cortices develop at similar rates, and preserve their plasticity into adulthood.

**Keywords:** procedural learning, development, learning capacity, plasticity

### **Sleep macrostructure, NREM sleep EEG spectra and their correlations with perceptual learning in WS**

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Williams syndrome (WS) is a neurodevelopmental genetic disorder characterized by a variety of physical abnormalities, sleep disturbance and a dissociative cognitive architecture with learning difficulties. To investigate the link between poor learning abilities and the altered sleep pattern in WS, a visual perceptual learning task was administered to 12 WS subjects (age range: 9–24 yrs), followed by the analysis of their night sleep. We applied a contour integration (CI) paradigm where stimuli are composed of collinear chains of Gabor elements forming an egg shape against a noise background. This task has been designed to study occipital (V1) visual function. All WS subjects also underwent two consecutive full-night home polysomnography. We analyzed sleep macrostructure and power spectra in specific EEG frequency bands at different scalp locations by using a mixed-radix FFT algorithm. Visually guided automatic scoring of leg movements (LM) was performed as well. While different measures of sleep macrostructure or leg movements during sleep are not predictive in terms of the ability to learn in CI, NREM sleep EEG spectra seem to have predictive power. As it has been shown earlier that perceptual learning in CI is sleep-dependent, this relationship between the altered sleep EEG pattern and learning in WS subjects might reveal an important link towards the genetic determination of sleep-dependent learning.

**Keywords:** perceptual learning, contour integration, polysomnography, sleep, Williams syndrome, adolescents and young adults

### **Monolingualism, bilingualism and the representation of emotional concepts**

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Some studies of autobiographical memory indicate that bilingual speakers experience reduced emotion when speaking in their second language, in opposition to the first. There is an often-held belief: the first language is the language of affect in a bilingual person. The majority of bilingual research has also found differences in the processing of emotional information in the first and second language. The aim of this research was to find out if there are statistically significant differences in the affective meanings of emotional concepts in Vojvodinian mono- and bilinguals. In our study, we wanted to examine if there are differences in the connotative or affective meaning of 12 emotionally laden words in the two language. Another aim was to see if the emotion words exert the same influence and interference effect in both languages using the Emotional Stroop task. The Emotional Stroop task provides an experimental measure of selective attention to emotional information. Using this task we can see how automatic the access to the words in the task is. This way, the Emotional Stroop captures the emotional relevance of the word for the individual. In the examination we tested Vojvodinian Hungarian–Serbian bilinguals and Serbian monolinguals. As a method we used semantic differential with adjective scales and emotional words in Hungarian and Serbian. The other method we used was the Emotional Stroop task, con-

sisting of neutral and negative emotion words. Our preliminary results from the semantic differential with four words show that the bilingual group rated emotionally positive words more positively and emotionally negative words more negatively than monolinguals, so that the bilingual answers are more extreme than the monolingual and this indicates that there are differences in the experience of the emotion words.

**Keywords:** semantic differential, Emotional Stroop task, bilingualism, monolingualism

**Attention affects the formation of regularity representations:  
An MMN study**

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No or only a very small MMN is elicited by violating some task irrelevant acoustic regularity when a concurrent sound sequence delivered to the other ear is task relevant. This effect can be interpreted as a bias of the competition for processing resources. MMN elicitation requires both the formation of a regularity representation (for the standard sounds) and the detection of a sound violating this regularity (the deviant sound). We tested whether one or both of these processes are affected by selective attention. Participants were on line instructed either to detect intensity changes in the tone sequence presented to the left or the right ear (attend sound conditions) or to detect changes of the visual fixation cross presented on a computer screen (neutral condition). 1500 Hz and 2600 Hz pure tones were delivered to the left and right ear, respectively, in a sequence that alternated between the two ears with a random SOA (170–370 ms). Intensity changes of 10, 15, or 20 dB occurred with 6.25% probability, separately in the two ears. The task changed between the neutral and one of the two possible attend sound conditions on average every 10.8 s. When most standards were unattended, and the subsequent deviant was delivered during neutral condition, no MMN was elicited. In contrast, when the deviant was unattended and most of the preceding standards were delivered during the neutral condition, MMN was elicited. These results suggest that some attentional capacity is necessary for detecting acoustic regularities and/or forming representations for them.

**Keywords:** selective attention, regularity representation, mismatch negativity, acoustic regularity, binaural stimulation

### Eye-tracking evidence for processing quantified utterances

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Quantified utterances (e.g. Some eggs have been eaten, All candles have been lit up, etc.) have been studied in logic for more than two thousand years. However, a question of how language users process quantified utterances is a relatively new pragmatic/semantic topic. In this study we tried to find out how language users resolve vague quantified expressions that have a form “Some A’s are B’s”. The eye-tracking study used a typical listening paradigm in which sentences were presented to the participants in headphones while they were viewing pictures that correspond to the sentences. The participants had to choose the correct picture. The experimental conditions (i.e. the pictures presented) varied in terms of quantity of the presented objects (e.g. one, two, three or four candles being lit up). The participants were 40 psychology and speech & language pathology students. The results were analyzed in terms of gaze duration, first fixation and choice. They suggest that language users tend to interpret the vague quantified expressions “Some A’s are B’s” as “At least one A is B”.

**Keywords:** sentence processing, quantified utterances, vagueness, eye-tracking

### Perceptual effect on motor learning in the serial reaction time task

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Although the Serial Reaction Time Task (SRT) has been an effective tool in studying procedural learning for a long time, it is still debated whether learning in the task is effector-based, perceptual-based or motor-based learning. The current research deals with the contrast of motor- and perceptual-based learning. A two-dimensional setting is employed which allows the use of motor and perceptual information both selectively and simultaneously. Results show that sequence learning takes place if the sequence is only made up of response information (motor learning), i.e. in the lack of a perceptual sequence, while there is no learning if the sequence is only present in the stimulus. We also found evidence that when motor and perceptual information are in conflict, each may interfere with learning in the other domain: the introduction of systematic non-sequential perceptual information reduces implicit motor learning, and with a motor sequence present, the effect of frequency is less pronounced. This result argues against both pure perceptual and pure motor learning hypotheses, and suggests that learning is primarily motor-based, but it is constrained by perceptual information.

**Keywords:** implicit learning, sequence learning, motor-based learning, perceptual-based learning, serial reaction-time task



### Episodic component in inhibition of return of attention

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Inhibition of return of attention (IoR) refers to the inhibition of oculomotor activity governing the return of attention to already attended locations during visual search. IoR is observed in spatial attentional tasks in which one of two possible locations of the upcoming target is cued exogenously (i.e. the cue location having no information about the location of the forthcoming target). IoR manifests as a slower response to target stimuli presented at the cued location when compared to uncued locations if the target appears with a delay of more than 300 milliseconds after the cue. It has been proposed earlier (Tipper et al., 2003) that inhibitory processes underlying IoR can be encoded in episodic memories and that the same inhibitory processes are reactivated upon retrieval of the episode or its context. If so, manipulating episodic encoding of target-context composites should influence IoR as well. For this end we used human faces as target context and manipulated the episodic nature of encoding processes by familiarizing participants with half of the faces before the IoR task. Our results clearly show that IoR is larger for targets encoded with episodically encoded faces than for targets encoded with new faces. This means that IoR is influenced by episodic encoding of target-context composites. However, the link between the magnitude of this short-term IoR gain and the appearance of long-term IoR is yet to be investigated in further experiments.

**Keywords:** inhibition of return, episodic memory, faces, exogenous cueing, context memory

### Experimental evidence for vagueness

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Vagueness is regarded as an important feature of human languages; human communication would be difficult if the precise meaning of every word were required in order to exchange a message. However, vagueness is a source of problems; the problem of propositions with vague predicates is well known from the classical times. In linguistics this corresponds to the question of how to determine the meaning of the vague statements. Today three main approaches remain in dealing with the vague statements: the classical Aristotelian approach in a form of componential analysis; the prototype theory with the full-specification approach as its variant (the idea that polysemy is not a surface phenomenon, i.e. that all meanings including the metaphoric ones are part of the word's representation in the mind); and the idea that the meaning of a word is specified in the context, i.e. in the usage while the words are underspecified in our minds. The experiments are aimed at determining the “psychological reality” of the theories of meaning that address the question of vague statements. The first experiment is a picture-matching task in which a participant decides whether a vague and a non-vague word matches the photographs shown previously. The second experiment is the opposite: it is a word matching task in which a participant decides whether a photograph is a match to the – vague or non-vague – word that was previously presented. The results are generally consistent with the “language-as-action” approach.

**Keywords:** vagueness, event-related potentials, meaning of the word

### Developmental dissociation between number fact memory and mathematical reasoning skills

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The developmental dyscalculia literature reports correlations between number fact memory deficits and low mathematical ability in children. In contrast, the adult neuropsychological literature reports double dissociations between these two types of maths skills. This study investigates developmental number fact impairment in an otherwise normal, highly educated, successful, middle-aged female professional with superior math skills. In addition to reporting number memory failures in everyday life, she self-reported significantly more memory failures (19%) for the multiplication facts between  $2\times$  and  $9\times$  than six female control cases which were closely matched for education, achievement, age and intelligence (.02% failure). This self report was confirmed by significantly longer latencies and significantly more errors on timed production of those facts. A further finding, that both she and her controls showed implicit memory only for multiplication facts with products greater than 25, suggests that basic number fact abilities rely on a combination of basic numeracy ability for smaller facts, and rote verbal memory for larger facts. This body of data is relevant to ongoing discussions about the nature of number fact processing in normal and impaired populations, child and adult, to discussions about educational practice, and to discussions about the basic nature of mathematical cognition.

**Keywords:** dyscalculia, developmental number fact impairment, implicit memory, subitization, rote verbal memory, maths cognition

### Object perception and memory for objects in communicative context

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We investigated whether the social context in which an object is experienced influences its representation. We hypothesized that when an object is observed in a communicative context, its permanent features (such as its shape or color) will be preferentially encoded at the expense of its transient features (such as its location). In the first study we presented movies, in which an actor either performed a reaching gesture towards one of 5 objects, or communicatively pointed at one of them. In a subsequent static image either the location or the identity of an object changed. Our results revealed that change detection for location was better in the reaching context and better for identity in the pointing context. Our second study investigated the long-term effects of communication. In each trial, a demonstrator took out a colored shape from one of 5 colored boxes either in a communicative, or in a non-communicative way, while participants' task was to memorize which shape belonged to which box color. We found that the participants who saw the communicative version performed worse in the task than those who saw the demonstrations without any communication. Moreover, communication biased answers towards responding with the task-irrelevant colors of the shapes. These results suggest that, when a situation involves communication, people tend to pay more attention to, and memorize more of, permanent object features.

**Keywords:** communicative context, object perception, memory for objects, permanent object features, transient object features

### **Worry is associated with enhanced memory performance**

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The cognitive avoidance theory of worry states that during worry, the arousal-evoking mental images associated with future aversive events are inhibited, and the processing of verbal information (worrysome thoughts) is enhanced. To perform this, high worriers need effective executive functions, in particular, effective inhibitory control. If this is true, then worrying must be associated with better executive and memory functions. We have carried out three studies to test this hypothesis: In Study 1, the link between different conceptualisations of anxiety and different forms of memory was examined using self-report questionnaires. As results show, whereas trait anxiety has an overall negative effect on memory performance, worry is associated with a better memory performance – in particular when the retrieval cue is self-generated. In Study 2 and Study 3, the effect of worry on cognitive performance has been investigated further using simple free recall and recognition tests. The results show, that worry has a positive effect on free recall memory performance, whereas recognition performance is unaffected. This pattern of results is in accord with the hypothesis of effective inhibitory functions in high worriers. The results could make some contribution to the emerging field linking cognitive control mechanisms, emotional regulation and memory.

**Keywords:** trait anxiety, worry, episodic memory, free recall, recognition-inhibitory control

### **Aesthetic or grammatical? – The role of melodic factors in linguistic variation**

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The goal of this work is to show that melodic factors of language, like the rhythm of the text, rhyming and phonological similarities of morphemes, do interact with grammar contrary to the generative assumption that they fall outside linguistic competence and only influence performance at best. Following Rebrus and Törkenczy (2009), I assume that variation occurs at the unstable points of grammar. Unstable points are those where the form and/or the function of an expression is influenced by more contradictory but equally strong effects. Preliminary results of a grammaticality judgment test with 37 subjects suggest that the role of melodic factors highly increases at the unstable points. The present study will further explore this with the aid of multiple-choice tests in two phenomena in Hungarian. The one case is the variation of object agreement where the instability is caused by conflicting syntactic and semantic factors, while the other case is the paradigmatic variation where the instability is the result of conflicting morphophonological effects. My aim is to show that there is a gradual scale from cases where speakers have clear intuition about grammaticality to cases where speakers' judgments are equally influenced by "grammar" and by "performance effects".

**Keywords:** competence/performance, object agreement, paradigmatic variation, instability, rhythm, rhyme

### **On the interaction of syntax and semantics: An ERP study**

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As a contribution to the controversy over the purely formal nature vs. semantic dimension of syntactic constructions in linguistics, we conducted an experiment using electrophysiology (Event Related Potentials), in order to determine (1) whether the semantic aspects of language are processed (by the brain) independently or in interaction with the syntax, (2) what contribution the transitive construction makes to the meaning of the sentence. To test these points, we made use of “transitive coercion” (a transitive construction was applied to an intransitive verb) in French and manipulated the semantic component by applying an object that was semantically either congruent or incongruent with the semantics of the verb. In our linguistic experiment, two main electrophysiological components were at work : the N400, classically considered to reflect difficulties in semantic processing, and the P600, supposed to reflect syntactic processing. The analysis of the ERPs elicited by the different types of SVO sentences (with vs. without syntactic coercion, combined with semantic congruence vs. incongruence) in our experiment clearly indicated that the processing of semantic information influences syntactic processing and that semantics and syntax are not processed independently. Moreover, a second experiment revealed an interesting graduality of semantic context with threshold effects.

**Keywords:** syntax, semantics, interaction, French, ERPs

### **Dreaming and affective regulation: Preliminary findings and a neurocognitive framework**

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Different lines of research suggest that REM sleep and dreaming involves the intense functioning of an emotional frontolimbic network facilitating off-line emotional information processing (Walker, 2009). Moreover this emotional processing may facilitate the regulation of affective states, by restructuring emotional memories into broader cortical networks. In accordance with Levin and Nielsen’s model (2007) we suggest that the emotional regulation in dreaming is served by the formation of a narrative structure, creating new, adaptive contexts for the emotional memories. Frequent nightmares may be viewed as the failure of this integrative process, therefore investigating dream disturbances of different populations can foster our understanding of the dysfunctional affect regulation in sleep. In our preliminary, questionnaire based studies we investigated the dream disturbances in Borderline Personality Disorder – characterized by fronto-limbic dysfunctions – and found that dream disturbances were linked to the severity of emotional dysregulation, and negatively correlated with waking levels of fantasy. In our second study we investigated the long lasting effects of early maternal separation on dream affect, and found a significant association between early (before 1 year of age) maternal separation and negative dream affect. Our results and future directions are discussed within a neurocognitive framework.

**Keywords:** nightmare, dreaming, Borderline Personality Disorder, separation, emotional regulation

### **Mediating variables of correlation between working memory and reading comprehension at 9–12 years**

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A simple association between performance in working memory (WM) tasks and reading comprehension not necessarily involved a causal relation and the mechanisms mediating this correlation have to be highlighted. In the first study, WM (measured by reading span), resistance to proactive interference and reading comprehension was tested on 145 children from 9 to 12 years old. ANOVA results show a significant effect for each factor and for their association. In the second study, on the same group of participants, explicative regression results show that the level of activation of irrelevant information mediates WM capacity in reading comprehension tasks. But the effect of WM capacity on reading comprehension cannot be reduced to a single variable and that is why, in the third study, we propose a regression analysis which shows what percent of variance is explained by cognitive inhibition when we put other variables as short term memory and processing speed in equation.

**Keywords:** working memory, cognitive inhibition, short term memory, processing speed, reading comprehension

### **On the influence of affect on cognitive control**

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The aim of this research was to check whether executive control might be influenced by the impact of emotions. This research sought to examine how the affect (positive and negative) influenced the task-switching costs. The author expected an increase of task-switching cost under negative affect and a decrease of switching costs in case of positive affect. A hundred people were examined, most of them were students of Jagiellonian University. In order to estimate the task-switching costs a task cueing paradigm (Meiran, 1996) was used. The affect was introduced by using emotionally affected photographs from International Affective Picture System (Lang, Bradley & Cuthbert, 1997). The results indicated: (1) a decrease of switch costs under the positive affect, (2) an increase of switch costs in task-switching under the influence of negative affect. These results are consistent with the predictions of the neurobiological theory of positive affect (Ashby, Isen & Turken, 1999). In order to estimate tasks-witching costs more precisely under the affect conditions, the costs of retrieving the hints and rules from the memory need to be distinguished from the costs connected with the process of task reconfigurations (Mayr & Kliegl, 2003). Further data is currently being collected to address this concern.

**Keywords:** executive functions, cognitive control, task-switching, affect

### **The electrophysiological correlates of directed forgetting**

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In our study we analyzed the psychophysiological correlates of directed forgetting and subsequent memory effect by assessing the EEG correlates of encoding of relevant and irrelevant information. 44 emotional (negative) and 44 neutral words were presented in two lists, each followed by either an instruction to remember or to forget. Then these 88 words, together with another 88 new words, were presented and the subject had to perform an old/new recognition task. After the test phase the recognized words were presented and the participants had to perform a source memory task. The EEG was recorded during the study phase. Besides the traditional ERP and EEG spectral methods the EEG was also analyzed by quantifying its linear (Omega-complexity) and nonlinear (Synchronization likelihood) properties. We assumed based on the source memory test that episodic memory processes are involved in intentional forgetting. The behavioral results showed forgetting effect for the F words which support the validity of intentional forgetting with the word method. The EEG analysis indicated ERP differences (N2, P3, N4) between the irrelevant and relevant information encoding which was modulated by emotional content of the item. The electrophysiological results point to separate enhancement and inhibition mechanism beyond the phenomenon.

**Keywords:** directed forgetting, word method, linear and nonlinear EEG analysis, emotional content, subsequent forgetting effect, source memory test

### **Face similarity – Why do we perceive two faces similar to each other?**

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This experiment was designed to explore the importance of different inner facial features (eyes, mouth, nose, eyebrows and chin) by their role in face similarity. Pictures of four middle-aged women (reference-faces) have been taken and processed using photo-editing software: a feature of one face has been replaced with the same feature of another face. All four faces have been graphically blended with each other in all possible combinations, yielding 12 groups of pictures, each consisting of 5 face-blends. Two kinds of picture-sets have been built as stimuli: first a base-face as reference and 5 face-blends that have been built on that base-face, second a feature-face as reference and 5 face-blends, each having one feature of that feature-face. Participants were asked to provide judgement for the order of similarity within the sets beginning with the face-blend that is most similar to the reference-face. Results showed that a general order of importance exists for the inner-features in face similarity (most-important first): eyes, mouth (not significantly less important than eyes), nose, eyebrows and chin. Further analysis showed that this order is a result of two effects: the personal properties of the observed faces, and the personal preferences of the participants (as observers).

**Keywords:** face-similarity, face-features, inner features, face recognition, face-blending

**A connectionist simulation of impaired perceptual integration in autism***Zsombor Várnagy<sup>1</sup>, Miklós Györi<sup>2</sup>*<sup>1</sup>Department of Cognitive Science, Budapest University of Technology and Economics, Hungary<sup>2</sup>Institute for Psychology of Special Education, Eötvös Loránd University, Budapest, Hungary  
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Connectionist modeling is an important tool in understanding the cognitive background of atypical developmental disorders. In this study we focused on autism, more specifically on atypical categorization. Since hardly any study tried to reproduce specific empirical results in this field, this was our main purpose. As a second aim, we expected that simulations may add important insights on the modeled phenomenon. In the empirical study – results of which we attempted to reproduce by simulation – of Booth (2006), a group with autism spectrum disorder (ASD) showed significantly poorer performance in recognizing objects by their fragmented contours than a typically developing (TD) group. In accordance to Weak Central Coherence theory of autism, the results were interpreted as persons with ASD were less able to integrate pieces of information (pieces of contours in this case). In our simulation based on Cohen's model of autistic information processing we used artificial neural networks with high and low computational capacities to model ASD and TD processing, respectively. Stimuli with different degree of contour fragmentation were translated into stimuli with various degree of distortion. Our simulation results show that higher capacity networks show similar impaired performance as compared to lower capacity networks, as ASD subjects compared to TD subjects. Moreover, in our simulations we found that noise ratio plays a crucial role. ASD networks were more affected and misled by noise than TD networks, while in the noiseless case ASD networks showed similar or even superior performance to TD networks.

**Keywords:** autism spectrum disorder, artificial neural network, fragmented pictures test, categorization, signal to noise ratio

## AUTHOR INDEX

- Agus, Trevor 2, 16  
 Albu, Mónika 4, 19  
 Arik, Engin 5, 19  
 Babarczy, Anna 6, 24  
 Bendixen, Alexandra 2, 17  
 Benyovszky, Máté 3, 34  
 Berencsi, Andrea 5, 25  
 Bódizs, Róbert 4, 5, 26, 32  
 Boha, Roland 3, 34  
 Boncsér, Ágnes 6, 20  
 Borisova, Irina 6, 20  
 Budimir, Sanja 5, 21  
 Cipora, Krzysztof 4, 21  
 Conway, Martin A. 3, 23  
 Csibra, Gergely 3, 30  
 Csóka, Szilvia 4, 32  
 Czajak, Dominika 4, 22  
 Czigler, István 4, 27  
 Daelli, Valentina 5, 22  
 Dartnell, Pablo 2, 17  
 Davelaar, Eddy J. 3, 30  
 Demeter, Gyula 3, 23  
 Denham, Susan L. 2, 17  
 Dryll, Elzbieta 3, 23  
 Dryll, Ewa Marta 3, 23  
 Duzcu, Halil 4, 24  
 Erisen, Özgür 4, 24  
 Fekete, István 6, 24  
 Fiser, József 1, 14  
 Forgács, Bálint 6, 25  
 Gaál, Zsófia Anna 3, 34  
 Gergev, Gyurgyinka 4, 19  
 Gerván, Patrícia 5, 25, 26  
 Gombos, Ferenc 5, 26  
 Gomez, David M. 2, 17  
 Grabovac, Beáta 6, 26  
 Győri, Miklós 5, 35  
 Háden, Gábor P. 4, 27  
 Hevey, David 2, 18  
 Hohenberger, Annette 4, 24  
 Hrzica, Gordana 6, 28  
 Kartushina, Aleksandrovna Natalia 2, 16  
 Kemény, Ferenc 2, 5, 18, 28  
 Keresztes, Attila 3, 29  
 Kovács, Gyula 3, 29  
 Kovács, Ilona 1, 2, 5, 10, 25, 26  
 Krbot, Magdalena 6, 29  
 Kuvač Kraljević, Jelena 6, 28  
 Laureano-Schelten, Sofia 2, 18  
 Losiewicz, Beth L. 5, 30  
 Lukács, Ágnes 5, 28  
 Madarász, Tamás 5, 25  
 Marno, Hanna 3, 30  
 Milković, Marina 5, 19  
 Molnár, Márk 3, 34  
 Németh, Kornél 2, 18  
 Olszanska, Aleksandra 3, 23  
 Padovan, Nevena 6, 28  
 Pajkossy, Péter 3, 31  
 Palmović, Marijan 5, 6, 21, 29  
 Peredy, Márta 6, 31  
 Pléh, Csaba 1, 2  
 Polonyi, Tünde Éva 6, 20  
 Pressnitzer, Daniel 2, 16  
 Racsmány, Mihály 3, 23, 29, 31  
 Robert, Stéphane 4, 32  
 Rusconi, Elena 5, 30  
 Sagi, Dov 1, 12  
 Šefer, Ana Branka 6, 29  
 Silverstein, Steven M. 1, 7  
 Simor, Péter 4, 32  
 Stan, Rosana 3, 33  
 Sussman, Elyse S. 4, 27  
 Szalardy, Orsolya 2, 17  
 Taraday, Maciej 4, 33  
 Thomas, Kevin 2, 18  
 Thorpe, Simon 2, 16  
 Tóth, Brigitta 3, 34  
 Treves, Alessandro 5, 22  
 Várhely, Klára 3, 34  
 Várnagy, Zsombor 5, 35  
 Winkler, István 2, 4, 17, 27  
 Żelechowska, Dorota 4, 21, 22