

BOOK OF ABSTRACTS

19th ANNUAL MEETING OF THE ASSOCIATION FOR THE SCIENTIFIC STUDY OF CONSCIOUSNESS

PARIS | JULY 7th-10th 2015



ASSOCIATION FOR
THE SCIENTIFIC STUDY
OF CONSCIOUSNESS



KEYNOTE SESSIONS

Acting without seeing: eye movements reveal visual processing without awareness

MARISA CARRASCO

New York University.

Using our eyes to actively explore the world and to gather information is a central part of human visual experience. Visual perception and eye movements are considered to be tightly linked. Diverse fields, ranging from developmental psychology to computer science, utilize eye tracking to measure visual perception and to infer cognitive processes. The link between eye movements and visual perception is so tight that perception is facilitated even during the preparation of eye movements. Recent behavioral studies, however, have challenged this prevailing view. Studies from my lab and other labs show converging evidence revealing dissociations between perceptual reports, that is, the contents of perceptual awareness and different types of eyes movements, both voluntary (e.g., saccades, smooth pursuit, and vergence) and involuntary (e.g., microsaccades, ocular following, and optokinetic nystagmus). Such dissociations reveal perception-action dissociations in which eye movements are sensitive to particular visual features, even though observers show no awareness of those features, as assessed by explicit perceptual reports: the eyes act on what they do not see. I will also discuss studies from my lab indicating that visual attention can alter perception of visual features, even in the absence of awareness. Moreover, I will mention neurophysiological, neuroimaging, and clinical studies supporting the role of subcortical pathways for visual processing without awareness. In a recent article (Spering & Carrasco, Trends in Neurosciences, 2015), we review these perceptual-eye movement dissociations, link them to awareness, and further our understanding of the brain pathways underlying vision and movement with and without awareness.

Avoiding pain: cortical responses to nociceptive stimuli and defensive movements

GIANDOMENICO IANNETTI

University College London.

Neuroimaging and neurophysiological studies in humans have shown that transient nociceptive stimuli causing pain elicit responses in an extensive network of cortical structures. This network, often referred to as the “pain matrix”, has been assumed to be specifically reflecting nociceptive processing, and extensively used in the past 30 years to gain knowledge about the cortical mechanisms underlying nociception and pain perception in humans. In the first part of this talk I will provide evidence that, in contrast with this dominant view, these brain responses are not specific for the perception of pain. These results indicate that it is incorrect to refer to these responses as originating from a “pain matrix”, and question the appropriateness of relying on them to infer that an individual is in pain, or to build models of where and how nociceptive input is processed in the human brain to generate painful percepts. Instead, I will suggest that the largest part of pain-evoked brain responses are related to detection of environmental threats – they represent a basic mechanism through which the individual detects, reorients attention and reacts to sensory events threatening the integrity of the body, regardless of the sensory channel conveying this information. In the second part of this talk I will illustrate the rules that the nervous system obeys to identify threatening changes in the sensory environment, and provide evidence that the brain responses elicited by a salient stimuli are sensitive to behaviourally relevant changes in the location of a potential threat with respect to the body. I will finally show that the brain responses elicited by transient nociceptive stimuli are related to the execution of defensive movements, aimed to protect the body from threats in the sensory environment. Furthermore, by exploring the dependence of such responses on the position of the threatening stimulus in space, I will show evidence

supporting the existence of a part of space surrounding the body (a “defensive” peripersonal space, DPPS) representing a safety margin advantageous for survival.

Implicit Social Cognition

MAHZARIN R. BANAJI

Harvard University.

How deep are the bounds on human thinking and feeling and how do they shape social interactions and decisions? For the past 30 years, I have studied mental processes that seem to operate without full conscious awareness or conscious control and also seem to be at odds with intentions and moral values and I have done so in the context of group memberships. From the moment of birth, every human is a member of many groups. By the opportunities and liberties offered or snatched away, group memberships shape lives ubiquitously and enduringly. Group memberships create affiliations of “us” and “them” and sensitivity to status in social hierarchies. In this context, we have explored the nature of implicit social cognition with a focus on specifying its magnitude, universality, specific dissociations from conscious cognition, developmental origins, neural signatures, malleability, and predictive role in clinical disorders like self-harm, as well as legal, business, and medical decisions.

Do Apes and Very Young Children Attribute Mental States ?

TYLER BURGE

University of California, Los Angeles.

A widespread view among philosophers and psychologists is that apes and human children well under age 4 have been shown to have rudimentary capacities for representing and attributing mental or psychological states. This view is disputed. But most of its critics have mounted positive views that either have been shown wrong or seem less promising. I believe the widespread view to be mistaken. I argue that it rests on conceptual confusion. I argue that there is no specific support for the view and that taking very young children and apes to be utilizing a scheme that centers on attribution of agency is better supported by existing evidence.

What’s the use of consciousness ?

CHRIS D. FRITH

Wellcome Trust Centre for Neuroimaging at UCL - Institute of Philosophy, University of London - Interacting Minds Centre, Aarhus University.

There is something very strange about conscious experience. It appears to be private and not accessible to anyone else, and yet it is the only aspect of my mental life that I can report to others. And why do I need any conscious experience at all when I can achieve so much without it? Thomas Huxley believed that consciousness was an epiphenomenon and ‘as completely without any power of modifying that working [of the body] as the steam-whistle which accompanies the work of a locomotive engine is without influence upon its machinery’. I shall argue that conscious is indeed like the steam whistle of a locomotive engine, in that it has a critical role in regulating interactions with other people.

Consciousness is a biological process that has evolved. Humans have much richer conscious experience than other animals and I believe that this gives us advantages. But what are these advantages? A great deal can be achieved without conscious experience including sensory integration, global information access, and flexible decision-making. But only through consciousness can we share our experiences with other people. Such sharing enables us to be influenced by the ideas of others and allows us to influence them. Such sharing creates advantages at many levels.

Consider, for example, the experience of action. Although our access to the cognitive processes underlying our actions is very limited we devote much time to justifying these actions to each other. Such discussions usually concern the experience of agency. This experience has little impact on our

immediate behaviour, but we have a vivid experience of being in control: it is I that am performing the action, and I could have done otherwise. The feeling that I could and should have done something else creates the strong emotion of regret.

In the long run discussions about our experiences of action lead to cultural consensus about when we can be held responsible for our actions. We distinguish between outcomes that were the consequence of deliberate, free actions and those that occurred accidentally. In most cultures punishment for bad behaviour depends upon degree of responsibility. Such punishment has a key role in maintaining social cohesion. The regret we feel when we violate social norms is an internalised form of such punishment. Consciousness, reportable subjective experience, enables the development of cultural consensus and allows the group to achieve more than its best individuals.

SYMPOSIUM SESSIONS

Unconscious Working Memory?

S. Marti [1], J. Eriksson [2], J.-R. King [1,3], D. Soto [4] & D. Trübutschek [1]

[1] Cognitive Neuroimaging Unit, NeuroSpin CEA Saclay, [2] Umeå center for Functional Brain Imaging, and dept. of Integrative Medical Biology, Umeå University, [3] Institut du cerveau et de la moelle épinière (ICM), Paris, [4] Imperial College London, Department of Medicine, Centre of Neuroscience, London.

William James (1890), the father of psychology, already stated what seemed to him an undeniable fact of life: “Without memory no conscious sensation, without memory no consciousness.” Since then, little has changed. Both conscious experience and working memory are widely regarded as inextricably linked, not only involving a similar network of brain regions, but also the ability to accurately report their contents. Prominent theories even feature awareness as a crucial and integral part of working memory, insinuating that the two may be indistinguishable. Recent evidence, however, questioned this view. Consciousness may neither be compulsory for working memory, nor may all of the contents of working memory be directly reportable. Instead, it seems possible that information can be maintained for several seconds outside the realms of awareness. If true, the field of consciousness research might have reached a critical turning point, opening up venues for refined theories and novel sets of questions. The purpose of this symposium will therefore be to further explore and discuss this exciting phenomenon, its nature, and implications: Was William James really wrong? Does unconscious working memory truly exist or has another unconscious process been discovered?

Levels of Consciousness

T. Bayne [1], H.Blumenfeld [2], A. Owen [3], L. Miracchi [4]

[1] Philosophy, School of Social Science, University of Manchester, [2] Yale Clinical Neuroscience Imaging Center (CNIC), Yale University School of Medicine, [3] Canada Excellence Research Chair in Cognitive Neuroscience and Imaging, The Brain and Mind Institute, Natural Sciences Building, The University of Western Ontario, [4] Faculty Fellow of Philosophy, New York University

Theories of consciousness are typically taken to involve two dimensions of analysis: one dimension concerns the organism's conscious contents, and the other dimension concerns the organism's conscious level. Relative to the amount of attention that the contents of consciousness have received, the notion of a conscious level has been neglected. The aim of this symposium is to bring together theorists from various perspectives in order to advance our understanding of levels of consciousness from both empirical and conceptual perspectives.

The symposium will address the following questions: How are the levels of consciousness are related to the contents of consciousness? How is the notion of a level of consciousness understood in the context of epilepsy, the vegetative state and minimally conscious state? Do different fields within consciousness science employ the same notion of a level of consciousness, or do different fields operate with distinct conceptions of a conscious level? How can one measure a creature's level of consciousness? And how might an account of levels inform theories of consciousness?

Consciousness without control: How do phenomenology and function change when prefrontal control is reduced and what does this mean for the development of consciousness ?

A. Gopnik [1], S. Thompson-Schill [2], R. Carhart-Harris [3], D. Whitney [1]

[1] Depts. of Psychology and Philosophy, University of California at Berkeley, [2] University of Pennsylvania, [3] Imperial College, London.

There has been extensive and important work in consciousness studies examining the relation between conscious phenomenology and prefrontal control. Conscious, top-down, endogenous attention and executive decision-making and planning are clearly related to distinctive patterns of frontal control and coordination. But what happens to phenomenology and function when prefrontal control is diminished or attenuated. Does consciousness simply fade or disappear? Or does it take different forms? This question is particularly important in understanding the development of consciousness, given that prefrontal control clearly increases with age. In this symposium, four investigators using very different methods describe function and phenomenology in cases of diminished prefrontal involvement. These include cases of electrical disruption of frontal function and administration of psilocybin and LSD, brief exposures of multiple crowded objects in “ensembles” and perception and cognition in young children. In all these cases prefrontal control is attenuated. There appear to be some striking similarities in function and experience in these cases. With diminished prefrontal control, attention, experience and cognition may become distributed rather than focused, holistic rather than analytic and more bottom-up and exogenously determined, rather than top-down and endogenously determined. There is also evidence for increases in flexibility, and in some kinds of learning and creativity. Attenuated prefrontal control may have some computational and cognitive benefits that balance the costs of diminished focus, inhibition and executive function, and may be accompanied by distinctive kinds of phenomenology. This may help us understand what it is like to be a baby or young child, and why.

The no-report paradigm: a promising avenue for consciousness research?

N. Tsuchiya [1], S. Frässle [2], M. Wilke [3], V. Lamme [4]

[1] School of Psychological Sciences Faculty of Biomedical and Psychological Sciences Monash University, [2] Department of Psychiatry and Psychotherapy, Philipps-University Marburg, Germany, [3] Department of Cognitive Neurology, University Medicine Goettingen, Germany, [4] Department of Psychology, University of Amsterdam, The Netherlands.

The core issue of consciousness research is the neuronal basis of conscious phenomenal experience. To study phenomenology, however, third-person experimenters seem obliged to resort to verbal or manual reports from the studied subjects to know about the presence or absence of consciousness. This might have biased much of the search for the neural correlate of consciousness (NCC) over the last decades. Have we not confounded the neural causes of consciousness with the consequences of consciousness? Did we not confuse the processes that generate visual experience with the cognitive processes enabling us to decide on the conscious content, attend to it, store it, and report about it? Recently, various studies tried to dissociate neural activity that gives rise to conscious phenomenology from the activity that enables the reports via executive and cognitive functions, including attention and working memory. In addition, new paradigms have been developed to study conscious experience in the absence of report. We will discuss those new approaches and ask whether they bring us any further in understanding consciousness. That is the topic of this symposium. It brings together scientists that have used no-report paradigms to study consciousness. Do their results really provide another perspective? Are our no-report paradigms suggesting NCCs different from the traditional approach? Or are we throwing away the baby with the bathwater? After presenting results and arguments, we will devote time to a panel discussion to answer these questions in a dialogue with the audience. Initial and final polls will engage audience and estimate the attitudes of the current researchers about reports, as well as the impact of the hereproposed symposium.

TALK CONCURRENT SESSIONS

**CONCURRENT SESSIONS: Wednesday, July 8th
(14:00 – 15:30)**

VISUAL CONSCIOUSNESS

The roles of repetition and prediction in perceptual attenuation

Fredrik Allenmark [1], Yi-Fang Hsu [1,2], Cedric Roussel [1], Florian Waszak [1]

[1] Université Paris Descartes, Sorbonne Paris Cité, Paris, France & Centre National de la Recherche Scientifique (CNRS; Laboratoire Psychologie de la Perception, UMR 8242), Paris, France, [2] Department of Educational Psychology and Counselling, National Taiwan Normal University, 10610 Taipei, Taiwan.

Self-generated stimuli are perceptually attenuated compared to externally generated stimuli in two ways, both referred to as sensory attenuation. The perceived intensity of the self-generated compared to externally generated stimulus is lower (e.g., Blakemore, Wolpert, & Frith, 1998; Sato, 2008) and discriminating between different intensities (e.g. contrast discrimination) is more difficult for self-generated stimuli (Cardoso-Leite, Mamassian, Schütz-Bosbach, & Waszak, 2010; Roussel, Hughes, & Waszak, 2013). Recently, repetition suppression, i.e. the decrease in neural activity that occurs when the same stimulus is repeated, has been discussed as a possible mechanism for sensory attenuation. On this theory sensory attenuation would be expected to occur not just for self-generated stimuli but also for stimuli that are repeated. In the present study we tested this hypothesis using a repetition priming paradigm. We used a contrast discrimination protocol with Gabor gratings with two different orientations. Two Gabors, prime and target, were presented in succession, each lasting 200 ms, with a 100 ms blank in between. The participants' task was to discriminate between two different levels of contrast of the target. In a first experiment the prime and target had the same orientation (repetition) on 50% of trials and opposite orientation (alternation) on 50% trials. We found that contrast sensitivity is lower when the same orientation is repeated, suggesting a link between neural repetition suppression and sensory attenuation. However, this leaves open the question of whether sensory attenuation occurred because of repetition as such or because the stimulus identity was predicted. We addressed this in a second experiment where we had two blocks, a repetition block with 75% repetition trials and an alternation block with 75% alternation trials. In this case, we found higher contrast sensitivity on repetition trials compared to alternation trials in the alternation block. Since, in the alternation block, alternation was more frequent than repetition and could therefore be predicted, this suggests that when repetition is not expected, it is prediction, not repetition that causes sensory attenuation. One possible mechanism that could explain this result is if unpredicted stimuli attract attention more strongly than predicted stimuli (Itti & Baldi, 2009; Spratling, 2012).

The role of the insula in suppressing synchronous cardio-visual stimuli from awareness

Salomon, R.[1,2], Ronchi, R. [1,2], Dönnz, J. [1,2], Bello-Ruiz, J. [1,2], Herbelin, B. [1,2], Martet, R [1,2], Faivre, N [1,2], Schaller, K. [4] , Blanke, O. [1,2,3]

[1] Laboratory of Cognitive Neuroscience, Ecole Polytechnique Fédérale de Lausanne, [2]Center for Neuroprosthetics, Ecole Polytechnique Fédérale de Lausanne,[3] Department of Neurology, University Hospital, Geneva, [4]Department of Neurosurgery, University Hospital, Geneva.

The processing of interoceptive signals in the insular cortex has been suggested to underlie self-awareness. To date it is not known whether interoception impacts other forms of awareness such as visual awareness and whether this is also mediated by insular cortex. Here, in a series of seven behavioral experiments (N=153), two high resolution functional MRI (N=16) as well as

neuropsychological patient experiments (N=12) we tested if visual awareness is affected by interoceptive information. Our results show converging evidence that the relative timing of visual stimuli with respect to the heartbeat modulates visual awareness. Awareness for visual stimuli synchronous to participants' heartbeat was suppressed compared to the same stimuli presented asynchronously to their heartbeat and other controls. High-resolution brain imaging showed that insular cortex was sensitive to both seen and invisible cardio-visual synchrony, and that BOLD responses to synchronous cardio-visual stimuli were suppressed specifically in the anterior insula region. Neuropsychological data from patients with cortical resections provided casual evidence that heartbeat-related suppression of visual awareness was mediated by insular cortex. Our results show that interoceptive insular processing impacts visual awareness, demonstrating that the insula not only mediates self-awareness, but also shapes our conscious experience of the external world.

Revealing columnar-level neural correlates of perceptual switches in area hMT using fMRI at 7 Tesla

Marian Schneider* [1], Rainer Goebel* [1,2], An T. Vu [3], Valentin G. Kemper [1], Miguel Castelo Branco [4], Kamil Ugurbil [3], Federico de Martino [1], Essa Yacoub [3]

[1] Faculty of Psychology and Neuroscience, Maastricht University, Maastricht, The Netherlands, [2] Department of Neuroimaging and Neuromodeling, Netherlands Institute for Neuroscience (KNAW), Amsterdam, The Netherlands, [3] Center for Magnetic Resonance Research, University of Minnesota Medical School, Minneapolis, USA, [4] Visual Neuroscience Laboratory, IBILI, Faculty of Medicine, Coimbra, Portugal.

* Authors contributed equally to this work.

Progress in ultra-high field fMRI now allows for probing functional responses at the level of cortical columns. While this progress has benefited mapping studies, it remains elusive whether it can advance the search for neural correlates of consciousness (NCC). Here, we addressed this gap by relating the conscious percept of plaid stimuli to columnar-level responses in the human motion complex (area hMT). When presented with a plaid stimulus, participants report two alternating conscious percepts: either two independent, transparent surfaces moving to the left and right, respectively, or a single surface moving in an intermediate (vertical) direction. In previous studies, we found that hMT is involved in mediating these perceptual switches (Castelo-Branco et al., 2002). We also showed that it is feasible to map columnar-level clusters in hMT that prefer specific axes of motion (Zimmermann, Goebel et al., 2011). Combining these two research lines here, we recorded responses in hMT columnar-level clusters in 5 participants, using 7 Tesla fMRI imaging with 0.8 mm isotropic resolution, in three related experiments: In experiment 1, we mapped clusters in hMT that prefer either horizontal or vertical moving dots. In experiment 2, we presented plaid stimuli that induced either horizontal or vertical motion by manipulating luminance at the intersections of gratings. In experiment 3, we presented ambiguous plaid stimulus and participants reported the perceived direction of motion by button presses. Experiment 1 allowed us to clearly label voxels in hMT as either "horizontal" or "vertical" motion clusters. When inducing horizontal and vertical motion (experiment 2), voxels preferring vertical motion overlapped with clusters identified as "vertical" in experiment 1, while voxels preferring horizontal motion overlapped more with "horizontal" motion clusters. For ambiguous plaids (experiment 3), reported horizontal motion percepts correlated most with voxel time courses in "horizontal" clusters, whereas vertical motion reports correlated more with time courses in "vertical" clusters. We thus show that the content of conscious perception for plaid stimuli can be read-out directly from dynamic activation changes in axes-of-motion selective voxels in area hMT. This indicates that the achievable mesoscopic level of investigation now offered by UHF fMRI can advance the search for NCC by enabling researchers to study responses related to specific contents of consciousness.

A Bayesian account of priming as the updating of perceptual expectations

Auréliane Pajani [1], Sid Kouider [1]

[1] Laboratoire de Sciences Cognitives et Psycholinguistique (ENS, EHESS, CNRS), Département d'Études Cognitives, École Normale Supérieure - PSL Research University, 75005 Paris, France.

The presentation of a picture from a given category (prime) is known to facilitate the processing of a subsequent picture from the same category (target), which results in shorter reaction times – a phenomenon termed 'priming'. Perceptual priors also facilitate the processing of stimuli from the predicted category. According to predictive coding models of perception, visual representations result from the integration between bottom-up sensory input and top-down predictions: valid expectations result in faster sensory processing. Priming can hence be thought of as a predictive phenomenon: a congruent prime would facilitate target processing because it acts as a predictive cue about target category. A consequence of this hypothesis is that priming should be reduced when target category is already predicted by the context. We investigated this assumption in a priming task in which target category probability varied across blocks. Participants were asked to make simple binary decisions on peripheral face and house targets (male vs female, two vs three stories), which were preceded by peripheral masked primes irrelevant to the task. Perceptual awareness was manipulated by varying prime duration (34 to 134ms), and target category probability was manipulated across blocks to induce expectations (e.g. 80% of face targets in 'face' blocks, 20% in 'house' blocks). Prime and target could either be identical or from opposite categories; priming size was defined as the difference between reaction times in those two equiprobable conditions. Results show an interaction between prediction and prime duration: priming increases linearly with prime duration, to a much greater extent for unexpected targets. This suggests that priming relies on the updating of perceptual predictions: target processing is facilitated by a congruent prime because it is used to update perceptual expectations about target category. This study sheds new light on the underpinnings of priming.

ALTERED STATES OF CONSCIOUSNESS

Cognitive Access and Cognitive Phenomenology: Empirically assessing the cognitive phenomenology hypothesis

Miguel Ángel Sebastián [1]

[1] Instituto de Investigaciones Filosóficas, UNAM.

The well-known distinction between A-consciousness and P-consciousness has moved away from the conceptual domain into the empirical one focusing on whether the neural mechanisms of cognitive access are constitutive of the neural correlate of phenomenology. In this paper I want to analyze the consequences that a negative reply to this question has for the cognitive phenomenology (CP) hypothesis---roughly the claim that there is a "proprietary" phenomenology of thoughts. If the mechanisms responsible for cognitive access can be disentangled from the mechanisms of phenomenology in the case of perception and emotion, the same is to be expected in the case of thoughts if there is CP. My aim in this paper is twofold:

First, I argue that if there is no distinction between thoughts we have cognitive access to and phenomenally conscious thoughts, then the CP hypothesis is jeopardized. The reason is that the most widely accepted theory of cognitive access, the Global Workspace (GWS), maintains that the mental states we have cognitive access to are those encoded in the center of the GWS. But we are assuming that a mental state does not acquire phenomenology in virtue of being encoded there. So, either there are thoughts with CP we lack cognitive access to or there are good reasons to doubt that there is CP.

Second, I present two problems in order to assess this disjunction. The first one is conceptual and I argue that we need to widen our current taxonomies of thoughts, which is based on reportability (between thoughts we have/lack cognitive access to) and deployment in reasoning (between occurrent and dispositional thoughts). I will show that, fortunately for the defender of CP, the empirical evidence makes room for such widening. The second one is empirical: how are we to evaluate the existence of occurrent phenomenally conscious thoughts we lack cognitive access to? I explore an alternative for

investigating such possibility combining thought suppression (when a thought is suppressed, we lack cognitive access to it, but, the empirical evidence shows, it is still occurrent) to look for the neural areas responsible for the cognitive access we have to our thoughts and neurophysiological research on N-REM sleep (where dreams tend to be thought-like). As it has been shown in the case of sensory phenomenology, if those areas are sufficiently deprived during N-REM, we would have evidence in favor of the claim that there are thoughts with CP we lack cognitive access to.

Learning and suppressing new information during sleep

Thomas Andrillon [1,2], Daniel Pressnitzer [3], Damien Léger [4], Sid Kouider [1]

[1] Laboratoire de Sciences Cognitives et Psycholinguistique UMR 8554, Département d'Études Cognitives, École Normale Supérieure, Paris, France, [2] École Doctorale Cerveau Cognition Comportement, Université Pierre et Marie Curie, Paris, France, [3] Laboratoire des Systèmes Perceptifs, CNRS UMR 8248, Département d'Études Cognitives, École normale supérieure, Paris, France, [4] Université Paris Descartes, Sorbonne Paris Cité, AHP, Hôtel Dieu, Centre du sommeil et de la Vigilance et EA7330, Paris, France.

When we fall asleep, our consciousness fades away. Even when we dream, we stop interacting with the outside world. Yet, a number of studies have shown the brain's ability to process external information. These processes range from automatic detections (e.g. own-name recognition) to contextual decisions on complex stimuli. Can these processes lead, as in wakefulness, to long-term changes detectable upon awakening? Only a few studies focusing on conditioning report signs of learning during sleep, often with conflicting results. We took advantage of a paradigm we recently developed (Kouider, *Curr. Biol.* 2014) to explore other forms of learning during sleep. We conducted two experiments, using EEG to precisely monitor participants' state and processes. In the first experiment (n=14 subjects), words and pseudo-words were presented to participants in wakefulness and NREM (Non-Rapid Eye-Movement) sleep. Memory for words heard exclusively during wakefulness or sleep was tested upon awakening (old/new paradigm). While there was no explicit recognition of words heard during sleep, there was a small effect on participants' confidence. Words heard during wakefulness led to strongly confident recognition and new items led to confident rejection, confidence judgments were impaired for words heard during sleep. This effect correlated with a strong central suppression in auditory potentials associated to sleep items. Thus, the processing of words during sleep lead here to a repression: a negative form of learning. In a second experiment, we used a noise-memory paradigm developed by Pressnitzer and col. The type of learning targeted here (fast, perceptual and automatic) is ideal for sleep studies. We performed a full-night study (n=20 subjects) that allowed us to explore both REM and NREM sleep. Items presented during wakefulness or during REM-sleep led to higher performance when tested the next morning, compared to the baseline for never-heard before items. Surprisingly, items presented during NREM sleep led to worse performances than baseline. Bearing on these intriguing results, we will present a unifying model of learning during sleep. On one hand, reactivated networks would be strengthened during wakefulness and REM sleep, leading to long-term memories. On the other hand, similar reactivations in NREM sleep would lead to synaptic downscaling and a lower performance upon awakening. These results clarify the mechanisms of memory consolidation, a key feature of sleep.

Preserved unconscious metacognition and impaired conscious error-detection in schizophrenia

Lucie Charles [1], Raphaël Gaillard [6,7,8], Isabelle Amado [6,7,8], Marie-Odile Krebs [6,7,8], Narjes Bendjemaa [6,7,8], Stanislas Dehaene [2,3,4,5]

[1] Department of Experimental Psychology, Oxford University, [2] INSERM, U992, Cognitive Neuroimaging Unit, [3] CEA, DSV/I2BM, NeuroSpin Center, [4] Univ Paris-Sud, Cognitive Neuroimaging Unit, [5] Collège de France, [6] INSERM U894, Laboratoire de Physiopathologie des Maladies Psychiatriques, Centre de Psychiatrie & Neurosciences, Paris, France, [7] Université Paris Descartes, Sorbonne Paris Cité, Paris, France, [8] Centre hospitalier Sainte-Anne, Service Hospitalo-Universitaire, Paris, France.

The ability to detect our own errors is an essential component of executive attention, action monitoring and metacognitive processes which are often impaired in schizophrenia. In particular, the Error-Related Negativity (ERN), a known brain marker of performance monitoring, is reduced in schizophrenia

patients. Using a masking paradigm in normal adults, we recently discovered that some performance monitoring processes can proceed without awareness, while others were tightly linked to conscious perception. Here, we used this experimental paradigm to determine if the error detection impairment in schizophrenia is specific to conscious perception or is also found under non-conscious conditions. Thirteen patients with schizophrenia and thirteen age-matched healthy control subjects performed a speeded number comparison task on masked stimuli while EEG and MEG signals were recorded. Conscious perception and error-detection were assessed on a trial-by-trial basis using subjective reports of visibility and confidence. We found that patients with schizophrenia presented altered cingulate error-detection responses in conscious trials, as reflected by a decreased ERN. By contrast, on unconscious trials, both controls and schizophrenia patients performed better than chance in evaluating the likelihood of having made an error. This dissociation confirms the existence of two types of performance monitoring systems, and suggests that deficits in schizophrenia are specifically linked to conscious metacognition while non-conscious performance monitoring remains preserved.

Breakdown of the brain's functional network modularity with awareness

Douglass Godwin [1], Robert L. Barry [2,5], René Marois [1,3,4]

[1] Department of Psychology, Vanderbilt University, Nashville, TN 37240, USA, [2] Vanderbilt University Institute of Imaging Science, Vanderbilt University, Nashville, TN 37232, USA, [3] Vanderbilt Vision Research Center, Vanderbilt University, Nashville, TN 37240, USA, [4] Center for Integrative and Cognitive Neuroscience, Vanderbilt University, Nashville, TN 37240, USA, [5] Department of Radiology and Radiological Sciences, Vanderbilt University Medical Center, Nashville, TN 37232, USA.

Neurobiological theories of awareness propose divergent accounts of the spatial extent of brain changes that support conscious perception. While focal theories posit mostly local or regional changes, global theories propose that awareness emerges from the propagation of neural signals across a broad extent of sensory and association cortex. While global models figure prominently in the theoretical landscape, there is scant experimental evidence in favor of truly sweeping, widespread changes in brain activity with conscious perception. Using a graph theoretical approach applied to ultra-high field (7T) functional magnetic resonance imaging (fMRI) data, here we experimentally tested a key tenet of global theories; the widespread emergence of large-scale functional connectivity with awareness. Graph theory analysis is an ideal tool to test global models of awareness because it can provide comprehensive measures of the integration and segregation of functionally connected areas of the brain. Participants performed a simple target detection task under three trial conditions (Forward-Masked, Backward-Masked, and No-Target), assessing both the presence/absence of the target and the confidence in their response. To determine whether consciously Aware and Unaware target states were associated with distinct global patterns of functional connectivity, we compared the differences in graph theoretical metrics between seen and unseen trials for high confidence ratings only. We first assessed pair-wise functional connectivity across 264 nodes of the cerebral cortex via the generalized psychophysiological interaction (PPI) method, and then submitted these data for graph theory analysis. These analyses revealed two metrics that were specifically modulated with awareness: Functional modularity – a measure of the ability to segregate the connectivity patterns into clearly distinct networks – decreased, while the participation coefficient – a metric assessing between-network connectivity strengths – increased, with target awareness. Strikingly, the same results were obtained when comparing false alarms to correct rejection trials. We conclude that awareness of a visual target is associated with a degradation of the modularity of the brain's functional networks brought about by an increase in inter-modular functional connectivity, thereby providing compelling evidence that awareness is associated with truly global changes in the brain's functional connectivity.

AGENCY

Is plural self-awareness prior to joint action?

Judith Martens [1]

[1] Institute for Philosophy II, Ruhr University Bochum.

Why do people choose to act jointly or to shift towards a plural subject? How can several people together become a collective? Why would individuals take a we-perspective? These are some of the main issues in collective intentionality and joint action. In Tomasello we find the idea that cooperation is the basis, or motivation, for behaving jointly. The capacity of cooperation frames our understanding of others' intentions, the capacity for joint attention, and joint action. His idea of cooperation as the motivation for social interaction seems a helpful basis for the main questions in collective intentionality that were raised above. Likewise, Godman (2013) argued for a social human being, with social interaction not the explanandum but the explanans of why we act jointly. Instead of appealing to a shared goal, intention, or representation, she suggests to appeal to a shared social motivation that drives joint action. Social experiences are rewarding in their own right. Therefore, no further reason seems necessary to understand why we act jointly. Schmid (2014) makes an even more radical suggestion. He argues for a new interpretation of the "sense of us" that many claim to be presupposed in collective intentionality. He argues for the introduction of plural pre-reflective self-awareness that plays the same role in the constitution of a common mind as does singular pre-reflective self-awareness in the individual mind. The "sense of us" is a characteristic of experience; pre-reflexive and non-thematic. It has often been claimed that self-awareness plays a constitutive role for the sort of unity in virtue of which the mind is somebody's mind. Self-awareness a) constitutes ownership (a formal unity of mind), b) creates perspective (what is "self" and what is not), and c) is the driving force behind normatively unified minds that are committed to consistency. Schmid argues that self-awareness may occur in the plural too. Joint intention presupposes a background awareness of plural selfhood, understood as a) common ownership, b) shared perspective, and c) joint commitment. And just as the individual self is not prior to individual self-awareness, plural self-awareness is what the plural self is. Based on this analysis of plural self-awareness I will reevaluate the motivations for joint action that Tomasello and Godman offer. In light of the idea of plural self-awareness, the motivational argument seems redundant. I will investigate whether it really is.

Consciousness, Control, and Moral Responsibility

Myrto Mylopoulos [1,2]

[1] Département d'Etudes Cognitives, Institut Jean Nicod/Ecole Normale Supérieure, [2] Department of Philosophy and Institute of Cognitive Science, Carleton University.

Many take it to be intuitively obvious that consciousness is in some way essential for free will, i.e., that set of capacities that an agent must exercise or possess in order to behave in such a way that she meets the requirements for moral responsibility. This intuition is not only commonly expressed among the folk (Shepherd 2012), but among neuroscientists (e.g., Libet 2004, 136), psychologists (e.g., Banks 2006, 236), and philosophers (e.g., Searle 2010, 129) alike. Still, despite this widespread endorsement, rarely is any careful consideration given to the question of **why** consciousness might be important for free will; it is often just taken for granted that it is. Recently, however, Neil Levy (2014) has offered a series of arguments in favour of this intuitive claim. On Levy's view, consciousness enables an agent to exercise certain kinds of executive control that are required for moral responsibility. In line with Global (Neuronal) Workspace Theory (GNWT) (Baars 1988; Dehaene, Changeux, & Naccache 2011), Levy views conscious mental states as those that are made available or broadcast to a range of consumer systems responsible for verbal report, deliberation, and rational action. Against a backdrop of empirical and theoretical considerations, he argues that consciousness, understood in this way, is required for (i) an agent to assess her mental states for consistency with one another, and (ii) the integration of a given mental state with other personal-level states. He further argues that each of these capacities is required for moral responsibility. Here, I take a skeptical stance, arguing that Levy fails to make a compelling

case. To be sure, if the GNWT is true, then consciousness is required for **some** degree of psychological assessment and integration. But what Levy fails to establish is that the degree in question is that required for moral responsibility. Drawing from the empirical literature, I offer some examples of relatively rich psychological assessment and integration in the absence of consciousness and I argue for the arbitrariness of viewing their conscious counterparts as exclusively relevant for attributions of praise and blame. I close by exploring the implications that moral responsibility may itself come in degrees, and that there may be good reason to adopt a weaker view on which, though not strictly required for it, consciousness is nonetheless a guiding **marker** of morally responsible behaviour.

How does the sense of agency come about? New theory about a tracking control process

Emilie A. Caspar [1,2], Andrea Desantis [2], Axel Cleeremans [1], & Patrick Haggard [2]

[1] Consciousness, Cognition and Computation Group (CO3), Center for Research in Cognition & Neurosciences (CRCN), ULB Neuroscience Institute (UNI), Université libre de Bruxelles (ULB), [2] Institute of Cognitive Neuroscience, University College London (UCL).

The sense of agency (SoA) refers to one's subjective feeling of control over one's own actions and their consequences. However, how human SoA comes about remains controversial. Here, we propose that the mechanisms responsible for the SoA involve real-time tracking control along the entire intention-action-outcome chain. Tracking control involves making sure that each successive step in the causal chain is successfully implemented before moving forward to the next step. To our knowledge, this proposal has never been experimentally explored in a SoA context. Imagine a Rube Goldberg contraption that involves a complex succession of specific events to achieve a desired effect. If a failure occurs during one of the steps and the desired effect is not produced, you will attribute this failure to the machine and will need to reconsider your erroneous expectations. However, if despite this failure the Rube Goldberg machine actually achieves the effect you intended, you will probably attribute this success to chance rather than to yourself. We surmise these internal vs. external attributions modulate our subjective experience of control in such a setting. To explore this hypothesis, we developed a procedure that involves an indirect causal chain more complex than used in typical SoA studies. Participants actively controlled a robotic hand that either carried out the same or different actions than those intended by participants (i.e., moving one's index finger either moved the hand's index finger or its ring finger). Further, the hand's movement resulted in an outcome (a tone) that could either congruent or not with the participant's intention. Participants were instructed to judge the delay between their action and the tone, as a proxy measure for SoA. In Experiment 1, we found that the contribution of outcome expectation on SoA judgements is significantly diminished when the robotic hand's movements are incongruent with participants'. In other words, the SoA is strongly modulated by the integrity of the causal chain. We replicated these results in Experiment 2, in which we also collected electrophysiological measures. These showed that auditory N1 was attenuated for congruent tones, but only when the robot action was also congruent. Our findings suggest that a real-time tracking control mechanism is responsible for the SoA, since a failure in early steps automatically reduced the feeling of control over the subsequent events.

Manipulating the Sense of Agency Using Suggestion, Deception, and Magic

Jay A. Olson [1], Mathieu Landry [2], Krystèle Appourchaux [3], Amir Raz [1]

[1] Department of Psychiatry, McGill University, Montreal, QC, Canada, [2] Integrated Program in Neuroscience, McGill University, Montreal, QC, Canada, [3] Department of Philosophy, l'Université Paris-Sorbonne (Paris IV), France.

People usually feel they control their thoughts and actions. When they do not, they experience a distorted sense of agency: thoughts or actions appear to originate from an external source beyond one's own will. These distortions can occur in mental disorders, under hypnosis, or during believed spiritual possession. We present a method to distort agency outside of these situations using suggestion, deception, and magic. Following Wegner's theory of apparent mental causation, we predicted that people would feel less control over their thoughts if they believed an external source was influencing

them. Accordingly, we introduced 46 participants to a brain scanner which could apparently read and influence thoughts. Participants entered the scanner and completed six trials of two tasks. In the Reading Task, participants would randomly choose a two-digit number which the computer would then correctly guess ostensibly by reading neural activity. It thus appeared as if the machine could read the participant's mind. In the Influencing Task, the computer would first choose and record a two-digit number which it would ostensibly influence the participant to choose. Participants again selected a number then saw that it matched the computer's choice. It now appeared as if the machine could influence the participant's decisions. In reality, the machine was a sham scanner and the reading and influencing were accomplished using a simple magic trick. Between each task, participants reported how voluntary their decisions felt using the Sense of Agency Rating Scale. Half of the participants were also interviewed about what they experienced when choosing the numbers. The results showed large distortions in the sense of agency. Participants reported less voluntary decisions during the Influencing Task than the Reading Task. Namely, their voluntariness scores were 0.92 standard deviations lower during influencing, 95% CI [0.67, 1.18], $t(45) = 6.24$, $p < .001$. In the Influencing Task, participants also took longer to choose their numbers (Mdn = 1076 ms longer, 95% CI [757, 1401], Mann-Whitney $z(U) = 6.67$, $p < .001$) and changed their minds more often ($M = .36$ more times, $p < .001$). Interview data corroborated these results. We could thus produce large agency distortions without hypnosis. This design could be used to model symptoms of mental disorders or to study the feeling of a free will.

CONCURRENT SESSIONS: Thursday, July 9th**(14:00 – 15:30)****SELF & MIND-WANDERING****Neural responses to heartbeats in the default-mode network encode the self-relatedness of spontaneous thoughts****Mariana Babo-Rebello [1], Craig Richter [1], Catherine Tallon-Baudry [1]**

[1] Laboratoire de Neurosciences Cognitives, Ecole Normale Supérieure, Paris – France.

The brain constantly receives and integrates signals from the internal organs (Critchley & Harrison 2013). By creating a dynamic and unified representation of the organism, these neural maps of visceral activity could generate a first level of self (Craig 2003, Damasio 2010). Neural responses to heartbeats have been recorded in the medial prefrontal cortex (Park et al 2014), a visceral center implicated in self-related processing (Northoff et al 2006). Here, we investigate the link between heartbeat-evoked responses (HERs) and the self. We considered the self in two distinct dimensions (Christoff et al 2011): the self-as-subject - the subject pre-reflectively acting, perceiving, and feeling; and the self-as-object - the reflective self, defined as the object of introspection. 20 participants fixated a screen and mind-wandered until a visual stimulus interrupted their spontaneous thoughts at random intervals. Interrupted thoughts were then evaluated by the subject on four continuous scales: the degree of involvement of the self as subject (low to high), the object of the thought (self/external), the time (past to future) and valence. We recorded magnetoencephalographic and cardiac activity to test whether the amplitude of HERs (evoked-responses locked to the T-wave of the cardiac cycle) before the interrupting stimulus reflected the orientation of the ongoing thought, on each scale. HERs significantly differed depending on the involvement of the self-as-subject during spontaneous thought ([298 327ms] after the T-peak, Monte-Carlo, $p=0.0397$).

Conscious Thought is a Subpersonal Process**Thomas Metzinger [1,2,3]**

[1] Philosophisches Seminar, Johannes Gutenberg-Universität Mainz, D-55099 Mainz, GERMANY, [2] Gutenberg Research College, Johannes Gutenberg-Universität Mainz, D-55099 Mainz, GERMANY, [3] Frankfurt Institute of Advanced Study, D-60438 Frankfurt am Main, GERMANY.

I will have two central goals in this talk, which explores the relevance of latest research on mind-wandering for theories of consciousness. First, conceptually, and in opposition to what many philosophers following Descartes and Kant traditionally have liked to believe, I will argue for the claim that conscious thought actually is a subpersonal process, only rarely a form of mental action, but rather an involuntary form of mental behaviour, and demonstrably for more than two thirds of our conscious life-time. The paradigmatic, standard form of conscious thought is non-agentive, it lacks veto-control, and involves an unnoticed loss of epistemic agency and goal-directed causal self-determination on the level of mental content. Second, I present an empirical hypothesis: There will be a detectable self-representational blink (SRB), a small time window in which we are blind to ourselves, namely, when shifting from one phenomenal self-model or “unit of identification” (UI) to the next. Alluding to the well-studied phenomenon of the attentional blink (Raymond, Shapiro, and Arnell, 1992, Shapiro, Raymond, and Arnell, 1997), the notion of a “self-representational blink” refers to the fact that we are typically not able to consciously experience the actual moment of transition from mindful, present-oriented self-awareness to the identification with the “protagonist” of a daydream, the content of the self-model in autobiographical planning, etc. Phenomenologically, the SRB is characterized by a brief loss of self-awareness, followed by an involuntary shift in the phenomenal UI; functionally, we can describe it as a failure of attentional and/or cognitive self-control. The empirical prediction is that subjects should be blind to self-related stimuli during the SRB, and my main hope is that the audience can help in developing

novel experimental paradigms to test this hypothesis. Metzinger, T. (2013g). The Myth of Cognitive Agency: Subpersonal thinking as a cyclically recurring loss of mental autonomy. *Frontiers in Psychology*, 4, 931.

Non-transparent thoughts: awareness of mind-wandering is a decisional mechanism

Mikael Bastian [1], Valentin Wyart [2], Jérôme Sackur [1,3]

[1] Laboratoire de Sciences Cognitives et Psycholinguistique, Département d'Études Cognitives, Ecole Normale Supérieure, EHESS, CNRS, PSL Research University, 75005 Paris, France, [2] Laboratoire de Neurosciences Cognitives, INSERM Unit 960, Département d'Études Cognitives, Ecole Normale Supérieure, PSL Research University, 75005 Paris, France, [3] Institut Universitaire de France.

We often experience irrelevant thoughts when we should instead pay attention to an ongoing task. Sometimes, we spontaneously notice that our mind has drifted away, while in other cases an external signal acts as a cue that calls our attention back on the task. Whatever the triggers, the mechanisms that generate the awareness of our own mental content remain unclear. At first, it might seem that such introspection is a direct and transparent process: people would immediately know what they are thinking about. On the contrary, we suggest that introspecting on one's mind-wandering is a decisional process, based on the accumulation of noisy introspective evidence up to a certain threshold. Using behavioral and pupillometric measures, we show in two experiments that, as for simpler perceptual decisions, participants' introspective decision criterion is open to experimental control, while their underlying experience of mind-wandering remains unchanged. In addition, we demonstrate that the introspective decision variable dynamically integrates subjective attentional state over up to 20 seconds before the report. Thus, introspections on the current content of our mind may use decisional mechanisms similar to those in perception and metacognition. We do not report whether we are focused or mind wandering as if we could describe unambiguous mental contents as seen from an open window. More likely, we make strategic decisions based on internal noisy evidence.

Implications of the “Lazarus Response” for understanding the relationship between for-me-ness and phenomenal character

Timothy J. Lane [1,2,3,4]

[1] Taipei Medical University, College of Humanities and Social Sciences, [2] Taipei Medical University-Shuang Ho Hospital, Brain & Consciousness Research Center, [3] Academia Sinica, Institute of European and American Studies, [4] National Chengchi University, Research Center for Mind, Brain, and Learning.

Previously I have argued that for-me-ness (FMN), pace the claims of philosophers like Zahavi and Kriegel (e.g., 2015), is not an invariant dimension of all phenomenal character (PC). Citing characterizations of certain pathologies and illusions, my previous arguments attempted to show that FMN and PC are related just contingently, because PC can occur in the absence of FMN (e.g., Lane 2012; 2014; forthcoming). Here I argue that data from our group's neuroimaging investigations of unresponsive wakefulness syndrome (UWS) suggest that FMN can occur in the absence of PC: our “Lazarus Paradigm” shows that some UWS patients exhibit distinctive task-induced activity in anterior Cortical Midline Regions upon hearing their own name or when called upon to distinguish autobiographical from non-autobiographical questions. In other words, it seems that that these patients exhibit a sub-personal level response indicative of FMN, despite exhibiting no indication of PC. I then proceed to suggest that this apparent double dissociation between FMN and PC might be an important clue to identifying a necessary condition for conscious experience, since the FMN or self-related (one's own name and autobiographical questions) responses exhibited by some UWS patients can be used to predict likelihood of responsiveness to drug therapies like zolpidem as well as likelihood of emerging from UWS. I conclude by giving qualified endorsement to a position advocated by Zahavi and Kriegel, to wit: FMN “is a minimum point of self-awareness.” If this “minimum point of self-awareness” is understood as the capacity to react to self-related stimuli on a sub-personal level in a way analogous to

the responsiveness of healthy subjects, then this minimal capacity—a sub-personal form of FMN—might prove to be a necessary condition for the having of conscious experiences.

PREDICTION & CONSCIOUSNESS

Generating Predictions Nonconsciously Evidence from Invisible Motion

Ariel Goldstein [1], Ido Rivlin [1], Ran Hassin [1,2,3]

[1] Cognitive Science Department, [2] Psychology Department, [3] Federmann Center for the Study of Rationality, Hebrew University, Jerusalem.

Predicting the future is essential for organisms like *Homo sapiens*, who live in a dynamic and ever-changing world. In this talk we challenge the modal view of the role of awareness in predictions. Previous research has established that conscious stimuli can lead to nonconscious predictions. Yet, it also suggests that conscious awareness of stimuli is a necessary condition for using them in predictions. We describe a set of experiments in which we used continuous flash suppression to expose participants to a subliminally moving object. After the object had stopped moving, a conscious probe appeared in a location that was either congruent with the future location of the moving object or not. Response times revealed a congruency effect, indicating nonconscious predictions based on subliminal motion. This result expands the known arsenal of nonconscious capabilities, as well as opens the door to further research using the paradigm.

The interplay between attention and consciousness in action-oriented predictive coding

Krzysztof Dolega [1]

[1] Ruhr-Universität Bochum Institut für Philosophie II

According to the predictive coding framework endorsed by Andy Clark (2013) and Jakob Hohwy (2013) the brain is performing hierarchically structured causal inference, where hypotheses about the possible causes of sensory input drive and constrain the system in a top-down manner. These cascading hypotheses terminate in the form of predictions about patterns of sensory input. Overall the system is driven to minimize prediction error by discarding inaccurate or imprecise hypotheses, meaning that it will tend to settle on an accurate model of external causes which allows it to successfully navigate the world. One of the key advantages of this approach is the promise of an explanation unifying the phenomena of endogenous and exogenous attention, as well as elucidating the role they play in determining conscious experience. Following Friston (2009), Hohwy (2012) proposes treating attention and perception as two distinct aspects of the same mechanism responsible for determining the contents of consciousness. On Hohwy's view endogenous and exogenous attention are both based on a mechanism for calibrating the precision of the error signal present in the system. By increasing the precision (and thus altering the reliability) of incoming prediction error, attention can alter which hypothesis determines the behavior of the system and the contents of conscious experience. The goal of this paper is to investigate the relationship between attention and consciousness in the predictive coding framework. More specifically, I will argue that under the probabilistic understanding of attention endorsed by Friston and Hohwy, attention is both sufficient and necessary for consciousness. The paper begins with an introduction showing that on this framework attention is treated as a distributed process penetrating the whole of probabilistic architecture, central in bringing about conscious experience. Having done this, I will discuss the 'bottom-up' effects in exogenous attention, such as cases of retroactively bringing content into consciousness, demonstrating that attentional modulation is sufficient for consciousness. Next, I turn to a more controversial claim that endogenous, 'top-down' modulated attention is necessary for consciousness due to the function it plays in the process of selecting content. The paper concludes with an observation about the possible incompatibility of the predictive framework with Ned Block's established phenomenal/access consciousness distinction.

Priors for perceptual decision and confidence in the pre-stimulus phase of occipital alpha-band EEG

Sherman, M.T. [1, 2], Kanai, R. [1, 2], Seth, A.K. [1, 3], VanRullen, R. [4, 5]

[1] Sackler Centre for Consciousness Science, University of Sussex, [2] School of Psychology, Pevensey Building, University of Sussex, Falmer, BN1 9RH, UK, [3] Department of Informatics, Chichester 1, University of Sussex, Falmer, BN1 9RH, UK, [4] Université Paul Sabatier, Toulouse, France, [5] Centre de Recherche Cerveau et Cognition, CNRS, UMR5549, Faculté de Médecine de Purpan, Toulouse, France.

It is now apparent that perception is facilitated by the top-down influence of prior expectation, as well as by attention. We have recently shown that perceptual confidence is also facilitated by prior expectations. However, the mechanism by which priors modulate objective and subjective perceptual decisions remains unclear. Recent work suggests that pre-stimulus α oscillations reflect attentional cycles which periodically modulate sensitivity. Furthermore, these have been implicated in the communication of top-down information. We therefore asked whether the influence of expectation on decision and confidence is rhythmic, predicted by the phase of pre-stimulus α/β EEG oscillations. We collected scalp EEG over 18 healthy subjects during a dual-task psychophysical paradigm, in which attention and expectation were orthogonally manipulated. The critical task involved the detection of a subthreshold, peripheral Gabor patch. Expectations of Gabor presence or absence were induced by changing the probability of its presentation and informing participants of these probabilities (25% or 75%). Attention was manipulated by instructing participants to perform or ignore a concurrent visual search task. Critically, the visual search array and Gabor were presented simultaneously, allowing time-locking to Gabor presence and absence. We also collected post-decision confidence ratings. Time-frequency (tf) decomposed pre-stimulus EEG activity over occipital electrodes revealed that ongoing 10Hz phase predicted yes versus no responses under full attention only. Phases at the tf point maximally predictive of choice were binned. This allowed us to compute independent bias and sensitivity measures as a function of attention, expectation and phase. Follow-up analyses under bias revealed that expectation-incongruent decisions were predicted by α phase. Under full attention, this effect was accompanied by liberal shifts in confidence. Collectively, our data provide evidence for an ongoing rapid, periodic alternation between top-down and bottom-up influences on decision in visual areas: At the preferred phase for prior influences, decisions were maximally biased by expectation and were maximally confident. On the other hand, at the suboptimal phases, where bottom-up signals exerted greater influence, confidence decreased. These data have implications for Bayesian theories of perception by indicating that expectations impose their influence at specific phases of oscillations.

UNCONSCIOUS PROCESSING

Disambiguating Mooney Images with Unconscious Prior

Raymond Chang [1], Alexis T. Baria [1], Biyu J. He [1]

[1] National Institutes of Health, National Institute for Neurological Disease and Stroke, Laboratory for Functional and Molecular Imaging.

Accumulating evidence has suggested that vision is not simply a passive, feed-forward process in which cortical areas relay progressively more abstract information to those higher up in the visual hierarchy, but rather an active, inferential process whereby top-down processes effectively guide and shape perception. Studies in modalities ranging from monkey neurophysiology to human neuroimaging have found that top-down influences from higher-order brain areas, including frontoparietal regions, benefit visual perception by modulating responses in early visual cortex. One major question that remains about top-down influences on visual perception is whether such processes can be influenced by unconsciously perceived stimuli. Neuroimaging work has shown that consciously perceived visual stimuli elicit stronger responses in higher visual and frontoparietal areas compared to unconsciously perceived stimuli, though the latter can still drive high-level behavioral responses such as inhibitory control. In light of this, we investigated whether unconscious perception of visual stimuli could yield a prior in the brain that guides subsequent perception. Using ambiguous black-and-white “Mooney” images, we first replicated the classic disambiguation effect of such images - Mooney images can be disambiguated by presenting the

original, un-thresholded grayscale photographs from which they were created. However, by masking these grayscale images such that they were presented at the subjective threshold of perception, we observed that even unconscious perception of disambiguating grayscale images could leave a prior in the brain that aids in visual perception of subsequently presented Mooney images. These findings suggest that visual processing is influenced by priors established by fleeting, even unconscious, perception. Furthermore, our results pave the way for future investigation on whether such perceptual priors are due to top-down feedback, or alternatively, local recurrent processes, and how unconscious and conscious processing differ in their influences on perceptual prior.

Inside the black box: Non-visual information can drive visual unconscious processing

Ziv Peremen [1], Nimrod Sarid [1], Dominique Lamy [1]

[1] Tel Aviv University.

Recent research suggests that when subjective perception is assessed using sensitive measures, forced-choice performance at discriminating various properties of a target reported as invisible is at chance level. A notable exception is blindsight: following a lesion to V1, patients report no subjective awareness of stimuli that they can localize or discriminate way above chance level. However, it is important to reflect on what above-chance performance actually means: simply that some information – any information – guides the observers' guesses. We suggest that this information is not necessarily visual. Here, we investigate whether healthy subjects can rely on non-visual (somato-sensory) information that is paired with an invisible arrow to achieve better-than-chance discrimination of the direction of this arrow. We found that pairing of the somato-sensory information or its relation with the subliminal visual stimuli, improved discrimination performance of the arrow direction that was paired with it, up to better-than-chance level. In follow-up experiments, we demonstrate that this effect does not result from arousal, temporal attention or a response-bias. Our results show that the association between a (sub) -liminal non-visual stimulus and a response can be learned. Such learning mimics the unconscious processing of visual information in Blindsight and might explain the dissociation between subjective reports and forced-choice performance in these patients.

Automaticity of sound-shape mapping

Shao-Min (Sean) Hung [1], Suzy J. Styles [2], Po-Jang (Brown) Hsieh [1]

[1] Neuroscience and Behavioral Disorders Program, Duke-NUS Graduate Medical School, Singapore, [2] Division of Psychology, HSS, Nanyang Technological University, Singapore.

The non-arbitrary sound-shape mapping (e.g. the Kiki-Bouba effect) has been shown across different language backgrounds and ages, suggesting consistent and universal associations between sounds and shapes (Köhler, 1929; Maurer, Pathman, & Mondloch, 2006; Ramachandran & Hubbard, 2001). However, the degree of automaticity of the sound-shape mapping still remains unknown. Here we show that the mapping can happen automatically without being consciously aware of the visual stimuli. In the first experiment, we measured the time taken to see a congruent pair (e.g. written word “kiki” with a spiky image) versus an incongruent pair (e.g. written word “kiki” with a rounded image) under continuous flash suppression. Our results show a “congruency effect:” congruent pairs of stimuli broke suppression faster than incongruent pairs. In the second experiment, we tested whether the congruency effect was due to visual congruency between the outline shapes and the English letter-forms (e.g., angular ‘k’, curved ‘b’): We trained people to pair the sounds “ki” and “bu” to unfamiliar letters from the West African Vai script – letters previously demonstrated to have neutral sound/shape mappings. After learning to map particular letter-forms to the sounds ‘ki’ and ‘bu,’ we discovered that congruent pairs (e.g. a spiky image with the Vai letters representing “kiki”) again broke suppression faster than incongruent pairs, suggesting that the congruency effect was due to a sensory alliance between the outline shapes and the speech sounds represented by the newly learned letters. Taken together, our results suggest that sound-shape mapping can happen automatically, and sensory congruency facilitates the access to conscious awareness.

Neural signatures of visual word form perception in an inattentional blindness paradigm

Michael Pitts [1], Kathryn Schelonka [1], Enriqueta Canseco-Gonzalez [1]

[1] Reed College, Portland OR, USA

In order to distinguish non-conscious, conscious, and task-related neural activity, a sustained inattentional blindness paradigm has been adapted to allow concurrent EEG recording. In this paradigm, visual awareness and task-relevance are manipulated in a step-wise fashion to improve separation between neural events linked with conscious perception and neural events associated with reporting one's perception. In previous studies we employed simple geometric shapes and line drawings of faces as stimuli. Here, we presented words, random consonant strings, and scrambled line segments during the three main phases of the experiment. In the first phase, subjects performed a difficult tracking task overlaid on a background of changing line segments. Unbeknownst to the subjects, the changing line segments formed words, consonant strings, or scrambled-line patterns (each presented 200+ times). Based on an awareness assessment following the first phase, ~40% of the subjects were deemed inattentionally blind to the words and consonant strings. The awareness assessment served as a cue such that in the second phase, subjects repeated the same tracking task, but were now aware of the words and consonant strings. In the third phase, subjects were tasked with detecting target words (animals), thereby rendering the words and consonant strings task-relevant. In all phases of the experiment, including inattentional blindness, a series of ERP amplitude differences were observed between words/consonants versus scrambled-lines (a posterior N1 difference from ~130-170ms, a bilateral occipital-parietal negativity from ~250-350ms, and a fronto-central N400 from ~400-600ms). These results suggest extensive non-conscious processing of word (letter) forms. The largest and most extensive ERP differences, akin to what some cite as evidence for "wide-spread cortical ignition", were observed only when the words became task-relevant in phase 3 (including a frontal positivity from ~250-350ms, and a parietal P3-wave from ~450-550ms). Awareness of the word forms, regardless of task-relevance, led to very modest changes in ERP amplitudes at middle and long-latencies. Overall, these results challenge several hypotheses put forward by the global neuronal workspace theory, and highlight the importance of distinguishing brain activity associated with conscious perception from activity related to carrying-out discrimination or reporting tasks.

CONCURRENT SESSIONS: Thursday, July 9th (17:30 – 19:00)

SELF & MIND-WANDERING

Extending the reach of perceptual conscious experience

Joulia Smortchkova [1]

[1] Ruhr-Universität Bochum

What kinds of properties enter into the conscious contents of perception? Do only sensory properties enter into conscious perceptual content, or can properties beyond the sensory ones also be perceptually experienced? We can formulate this debate about the reach of perceptual experience in terms of a choice between the following two views: i) Poor content view: only low level, sensory, properties (such as colors, shapes, orientations, etc.) are part of perceptual experience; ii) Rich content view: also high level properties contribute to perceptual experience, where high level properties are those that are not intuitively perceptual, for example: being a banana, being happy, being absent, etc. In my presentation I focus on the different ways in which we may establish the truth of the rich content view. In the first part of the talk, I underline a limitation of the phenomenal contrast method (Siegel, 2010), proposed to argue for the rich content view: this limitation stems from its failure to clearly distinguish between perceptual and post-perceptual (cognitive) phenomenal experiences. This failure is problematic also because the very same method of phenomenal contrast is also used to show that cognitive (non-perceptual) phenomenology exists (Siewert, 2011, Strawson, 2011). I argue that this distinction cannot be done on the phenomenological level alone and that we need to look at the underlying mechanisms to draw the line between perceptual and cognitive phenomenologies. In the second part of the talk I propose to look at experimental data that seem to offer a way to test for a truly perceptual effect: perceptual adaptation to high level properties (Webster and MacLeod, 2011; Block, 2014). In order to appeal to perceptual adaptation for deciding about cases of ambiguous phenomenology I reply to two potential objections. According to the first objection perceptual adaptation is limited to low level, sensory properties only. Against this objection, I show that perceptual adaptation is not limited to low level properties, but that there are cases when there is a clear effect concerning some high level properties (for example gender, age and emotional expressions of a face). The second objection appeals to cognitive adaptation, i.e. the idea that there might be cases of non-perceptual, cognitive, adaptation that trigger the effect. Against it, I rule out the possibility of cognitive adaptation that would trigger the same effects of perceptual adaptation.

Conceptual short-term memory and the richness of experience

Henry Shevlin [1]

[1] CUNY Graduate Center

Phenomenologically, it seems as though we enjoy conscious awareness of things we do not notice or think about. Ned Block (2011) has attempted to account for this intuition by claiming that conscious experience is richer than or 'overflows' cognitive access, and has presented a large amount of scientific evidence (such as Landman et al. 2003) in support of his view. Other theorists have claimed that our intuition is misleading, and phenomenology is limited by what we cognitively access (for example, Rosenthal 2005, Kouider 2010, Dehaene 2014). In this paper, I present recent psychological evidence for a form of high-capacity conceptual short-term memory (Potter 2014). This data suggests that perception involves numerous extremely rapid conceptual classifications that are briefly available but almost immediately forgotten. I go on to suggest that this evidence provides a way of reconciling opposing views about overflow. Specifically I claim that our phenomenology can be explained in terms of a difference in capacity between two cognitive mechanisms, namely working memory and conceptual

short-term memory. This lets us account for the relevant experimental data and to preserve many of the theoretical advantages of both kinds of theory of consciousness.

Block, N. (2011). 'Perceptual consciousness overflows cognitive access'. *Trends in Cognitive Sciences* 15 (12):567-575. Dehaene, S. (2014). *Consciousness and the Brain: Deciphering How the Brain Codes Our Thoughts*. Viking Adult, 2014. Kouider, S., de Gardelle, V., Sackur, J., & Dupoux, E. (2010). 'How rich is consciousness? The partial awareness hypothesis'. *Trends in Cognitive Sciences* 14 (7):301-307. Landman, R., Spekreijse, H. & Lamme, V. A. F. (2003) "Large capacity storage of integrated objects before change blindness." *Vision Research* 43(2):149–64. *Monographs* 74(11): 1-29. Potter, M.C., Wyble, B., Hagmann, C.E., & McCourt, E.S. (2014). 'Detecting meaning in RSVP at 13 ms per picture.' *Attention, Perception, and Psychophysics* 76(2), 270-279. Rosenthal, D.M. (2005). *Consciousness and Mind*. Oxford: Clarendon Press

Conscious vision proceeds from global to local content in both goal-directed tasks and spontaneous vision

Florence Campana [1,2], Ignacio Rebello [1], Anne Urai [1], Valentin Wyart [1], Catherine Tallon-Baudry [1]

[1] Cognitive Neuroscience Lab, Ecole Normale Supérieure, [2] Laboratory for Cognitive Computational Cognitive Neuroscience, Georgetown University Medical School.

Subjective visual experience – the way the world appears to us – is the core component of visual consciousness but its subjective nature constitutes a challenge for its empirical investigation. Here, we present a series of behavioral and electrophysiological studies using new stimuli showing that 1) the hierarchical organization of the visual system shapes the content of subjective visual experience, and 2) that the constraints that visual hierarchy places on consciousness in goal-directed tasks apply as well on the content of spontaneous subjective experience, in the absence of specific goals. We developed new and highly controlled textured stimuli that impose a hierarchical order of processing from local information (lines composing the texture) to global information (global shape embedded in the texture), and where local and global orientation can vary independently from each other. We show that consciousness accesses preferentially global representations arising from high-level visual areas: subjects are faster and more accurate at reporting global information. Access to local details can optionnally follow if required by short-term goals. Global information processing appears mandatory even when not task-relevant: it could be decoded from MEG signals at early latencies irrespective of the local or global nature of the task. Access to global representation is also dominant in spontaneous vision, when subjects are left free to report the dominant orientation in the stimulus, whether local and global. The frequency of reports of the global orientation in spontaneous vision is tightly correlated with objective performance when subjects are instructed to report global orientation. These results suggest that the content of subjective experience can be global, integrated, and meaningful but at the same time devoid from details. The existence of such coarse subjective experiences provides an explanation for results usually considered as contradictory, namely rich subjective experience accompanied by poor objective performance (Campana & Tallon-Baudry 2013). Our findings call for a reevaluation of the arguments used to disqualify subjective experience (Dennett & Cohen, 2011, Dehaene et al., 2006, Kouider et al., 2010), and for the use of graded measures of consciousness, able to capture coarse conscious percepts, rather than dichotomic detection tasks (eg the PAS scale (Ramsoy & Overgaard, 2004)).

Behavioral and electrophysiological evidence for fast emergence of visual consciousness

Henry Railo [1, 2, 3], Antti Revonsuo [1, 2, 3, 4], & Mika Koivisto [1, 2, 3]

[1] Department of Psychology, University of Turku, 20014, Finland, [2] Centre for Cognitive Neuroscience, University of Turku, 20014, Finland, [3] Brain and Mind Centre, University of Turku, 20014, Finland, [4] School of Bioscience, University of Skövde, SE-54128, Sweden.

A central unsettled dispute concerns how fast the brain generates subjective visual experiences. Early visual cortical activation and later activity in fronto-parietal global neuronal workspace both correlate with conscious vision, but studies have not been able to resolve which of the correlates causally triggers conscious vision. In the present study we employed a behavioral boundary condition to test whether an observed correlate is a consequence of consciousness: If a behavioral response to a visual stimulus is causally dependent on conscious vision, then the direct correlates of consciousness must occur before the behavioral response. By employing TMS of primary visual cortex (V1) at 90 ms, we were able to create conditions in which a high contrast visual stimulus was sometimes very clearly consciously visible and sometimes not at all consciously visible, while keeping the physical stimulation identical across conditions. Participants indicated conscious perception of a target using speeded button presses (go/no-go response) in addition to providing conventional subjective visibility ratings. By using concurrent EEG measurement we were able to compare the latencies of the speeded reports of consciousness to the neural correlates of consciousness in the same trials within participants. The results show that participants could report whether or not they consciously perceived a stimulus in just over 200 ms. These fast consciousness reports were extremely reliable, and did not include reflexive, unconscious responses. The neural events that causally generate conscious vision must have occurred before these behavioral reports. Single-trial analyses on the neural correlates of consciousness revealed that the late cortical processing in fronto-parietal global neuronal workspace (~300 ms) started after the fast consciousness reports, ruling out the possibility that this late activity directly reflects the emergence of visual consciousness. The fast consciousness reports were preceded by a negative amplitude difference (~160-220 ms) that spread from occipital to frontal cortex, suggesting that this correlate underlies the emergence of conscious vision.

METACOGNITION

Neural oscillations differentiating between task accuracy and metacognition

Martijn E. Wokke [1,2], Axel Cleeremans [2], K. Richard Ridderinkhof [1]

[1] Amsterdam Brain and Cognition, University of Amsterdam, [2]. Consciousness, Cognition and Computation Group, Université Libre de Bruxelles.

Decision-making is not always accompanied by full-blown consciousness. For instance, medical experts are able to make a diagnosis in a split second and professional tennis players know what to do at the speed of light. In these examples expertise allows for adept goal-directed decision-making, apparently without much conscious deliberation. Even-though explicit knowledge about how our decisions come about can be crucial, e.g., how a diagnosis was established, to date the emergence of this knowledge accompanying decision-making remains unclear and is hotly debated. In this talk I will address how conscious knowledge develops during decision-making and relates to first order performance (accuracy). For instance, in a visual detection task, the information being used for first order performance might differ from the information contributing to the build-up of knowledge about the decision process. I will present data demonstrating how explicit knowledge modulates neural responses during decision-making. We recorded EEG signals while participants were asked to make a diagnosis after seeing a sample (a complex visual pattern) of fictive patient data. This sample could either belong to a sick or to a healthy patient. Participants gradually learned to distinguish sick from healthy patterns, while indicating on each occasion how they made their decision (i.e., guessing, intuitive or rational choice and indicating the level of confidence). Single-trial analysis demonstrate that although increased accuracy is related to increased frontal theta band activity, enhanced metacognition is linked

to enhanced frontal beta band activity. These findings indicate that increased accuracy and enhanced metacognition during decision-making can be neurally distinguished.

Learning to feel the conflict: The effect of metacognitive training on executive control

Kobe Desender [1], Filip Van Opstal [2], & Eva Van den Bussche [1]

[1] Vrije Universiteit Brussel (VUB), Brussels, Belgium. [2] Université Libre de Belgique (ULB), Brussels, Belgium.

Why are our actions accompanied by subjective experiences? One possibility is that metacognitive experiences inform us when our actions do not proceed fluently. Metacognition might act as cue for the executive system to increase the degree of control. Indeed, it has been shown that the crucial requirement to improve control is not the conscious perception of interfering information, but rather the subjective experience of its cumbersome effect. From this, we predicted that training people to appreciate their metacognitive experiences should help them to more appropriately increase executive control. To test this, participants performed a conflict task, which is known to target executive control demands, at the start and at the end of this study. In between, participants performed three sessions of the same conflict task, during which they were provided with feedback on their metacognitive judgments, giving them the possibility to train this ability. The results showed a striking dissociation. Participants whose metacognitive performance significantly increased also showed improved performance following conflicts (i.e., increased conflict adaptation) in the conflict task, indicative of improved executive control. In contrast, participants who did not gain from this metacognitive training, and actually got worse, showed a marked decrease in handling conflicts in the conflict task. As this was not attributable to overall differences in response speed or accuracy, this cannot be accounted for as a general decline in performance, but reflects a selective decrease in executive control. We conclude that the functional role of metacognitive experiences is to efficiently deploy executive control, an ability which can improve with practice.

Using multivoxel pattern neurofeedback to selectively manipulate subjective awareness without changing perceptual performance

Aurelio Cortese [1,2,3], Kaoru Amano [2], Ai Koizumi [4], Mitsuo Kawato [1,3], Hakwan Lau [5]

[1] Nara Institute of Science and Technology, Nara, Japan, [2] Center for Information and Neural Networks (CiNet), NICT, Osaka, Japan, [3] Department of Decoded Neurofeedback, ATR Cognitive Mechanisms Laboratories, Kyoto, Japan, [4] Department of Psychology, Columbia University, New York, USA, [5] Department of Psychology, UCLA, Los Angeles, USA.

One important aspect of conscious awareness is subjective confidence. For instance, in the classic neurological phenomenon of blindsight, where subjective awareness is impaired, it is confidence rather than perceptual capacity that is abolished; these patients can discriminate visual stimuli above chance, although they claim to be just guessing with little confidence. Recent work using fMRI in humans as well as neuronal recording in animals have identified correlates of perceptual confidence in frontal and parietal brain regions. However, one issue is whether such correlates are causally critical for confidence to arise. A yet more concerning issue is that confidence is typically confounded with perceptual performance, so that these correlates may just reflect internal visual signal strength rather than subjective confidence per se. Here we used a recently developed method of fMRI neurofeedback, called decoded neurofeedback (DecNef), to address these issues. We first used multivoxel pattern analysis technique (sparse logistic regression) to learn the spatial pattern of brain activity associated with subjective confidence. Participants were presented with moving dot stimuli near perceptual threshold, and they made responses to discriminate between motion directions before they rated their confidence in each trial. Based on the fMRI activity recorded while subjects were performing these tasks, we computationally constructed a “decoder” from prefrontal and parietal regions that reliably classified between high and low confidence states. In subsequent experimental sessions, subjects were given online feedback of this decoded information, such that with monetary reward cues they were trained to implicitly induce different confidence states by directly changing their own brain activity. As predicted, we found that these induced brain states indeed led to differences in subjective ratings of confidence,

when subjects were presented with the same dot motion stimuli. This shows that these correlates of confidence in prefrontal and parietal areas are causally relevant. Importantly, self-induction of different confidence states based on DecNef was selective in that it left task performance unchanged. This ruled out the important confound that these correlates may just reflect motion discrimination capacity. These results demonstrate a novel method to robustly and non-invasively dissociate confidence and awareness from the basic mechanisms for perceptual decisions.

Perception, action and confidence: A Bayesian framework for metacognitive computation

Stephen M. Fleming [1,2], Nathaniel D. Daw [1,3]

[1] Center for Neural Science, New York University, [2] Department of Experimental Psychology, University of Oxford, [3] Department of Psychology, New York University.

Keeping track of the links between perception and action may be important for self-awareness and metacognition. Here we develop a Bayesian framework that formalizes metacognition as an inference on the efficacy of one's behaviour. Such inference models both a world state and one's own actions in the world, and recursively estimates a probability of success. By modeling shared and independent variability in percepts and actions in simple two-choice decisions, this framework provides a unified account of behavioural manifestations of metacognition often considered in separate literatures, such as confidence, error monitoring and changes of mind. Furthermore, the model also provides a rational perspective on dissociations between performance and confidence, and explains why actions may impact confidence independently of perception. To demonstrate the explanatory power of the model, we develop a novel confidence-judgment task that permits independent control of state and action precision via manipulation of pre- and post-decision sensory evidence. We suggest that metacognitive inference is a computational building block that permits self-knowledge in a variety of domains.

DEVELOPMENT & LEARNING

Behavioral and neural markers of error detection and decision confidence in infants

Louise Goupil [1], Sid Kouider [1]

[1] Laboratoire de Sciences Cognitives et Psycholinguistique (ENS, CNRS, EHESS), PSL Research University, Paris, France.

Past research documented a rather late development of metacognitive capacities. Yet, these studies were based on children's report about their own mental states. In this project, we investigated the possibility that even preverbal infants can demonstrate rudimentary forms of metacognition in simple and non-verbal settings. Specifically, we tested infant's capacity to monitor decision confidence, a hallmark of metacognitive sensitivity. Across several studies we found that, after performing a binary choice, and while nothing in the external world provides information about the correctness of their responses, infants show differential overt behavior following correct vs. incorrect decisions. A first study relying on post-decision search persistence as a proxy for metacognitive monitoring showed that 18 month-old infants appropriately compute confidence in their own decision. In addition, in a follow up study, we found that infants are able to use decision confidence to adaptively confirm their initial choice, or change their minds. Finally, in a third study relying on high-density electroencephalography (EEG), we show that 12 month-old infants can evaluate the correctness of their anticipatory eye movements. Furthermore, we show that infants elicit the equivalent of an error-related negativity, demonstrating that they can detect their own errors. Together those studies suggest that although explicit forms of metacognition mature later during childhood, implicit metacognitive abilities are present early than previously thought.

Color experience in newborn babies: A problem for representationalism ?

Claudia Passos-Ferreira [1]

[1] Federal University of Rio de Janeiro - Visiting Scholar at Columbia University (2015-2016).

Recent advances in developmental psychology can help us to address important metaphysical questions about the nature of the early stages of consciousness. What is the character of a newborn baby's consciousness? How does their consciousness relate to the external world? What if anything do they represent? Traditionally, early conscious states were conceived as undifferentiated, disorganized and passive. Newborns' experiences were reduced to an early sensory experience, as blob of chaotic sensations, what James (1980) famously claimed as 'a blooming, buzzing, confusion'. This picture has been greatly revised by recent developmental research, according to which newborns' conscious experiences have a much richer structure. These issues about the development of consciousness are of strong theoretical relevance for the philosophy of mind. The question of whether newborns have representational conscious experiences is a crucial test case for theories of consciousness such as representationalism, which holds that all conscious experiences have a constitutive representational structure. In this paper I use color experience in newborn babies to make a case against tracking representationalism. Tracking representationalism is the view (developed by Lycan (1996), Dretske (1995) and Tye (2000)) on which phenomenal experiences represent external properties that have previously been causally connected to the associated brain states. If tracking representationalism is true, then newborns have experiences of colors only if their associated states have been causally connected to colors. I will present empirical data suggesting newborns have experience of color and that they have these experiences before their brains have been causally connected to colors. Recent data concerning color vision – mainly research on perceptual integration and multisensory development, and neonatal synaesthesia – suggest that color perception development relies on genetically programmed maturation. This seems to support the claim that newborns color vision experience occurs independently of early perceptual learning and independently of a causal connection with physical properties (surface reflectance properties, in the case of color perception) of physical objects. I will use this developmental data to reject tracking representationalism.

Learning to become aware: Practice promotes a generalised ability to overcome visual suppression

David Carmel [1]

[1] University of Edinburgh, UK.

Very little is understood about plasticity in the processes underlying conscious perception. How do practice and familiarity influence the way stimuli gain access to awareness? Here, we investigated this by examining how the effectiveness of suppression from awareness changes with repeated exposure. In two studies, participants performed an orientation discrimination task on monocularly-presented gratings that were suppressed by either continuous flash suppression (CFS, a simultaneous high-contrast, dynamic image presented to the other eye; Study 1) or backward masking (a mask presented to the same eye immediately after the suppressed stimulus; Study 2). Despite some previous indications that both of these common suppression methods lose efficacy over time, this has not been investigated systematically. In both studies, around half of the participants were 'learners': by their fifth daily session, they could overcome suppression and make subtle orientation discriminations. This was accompanied by an increase in metacognition measures, indicating that the improved performance was not due to unconscious perception, but rather to stimuli reaching awareness. Furthermore, the improvements generalised to orientations orthogonal to those that participants had trained on, as well as to the other eye and a different spatial frequency, indicating that learning was not limited to plasticity in early, orientation-selective monocular neurons; rather, this pattern is consistent with a general mechanism whereby the visual system learns to reduce the weighting of suppressive masks in overall processing. Learning was stable and still present at a follow-up one year later. Interestingly, learning also generalised across suppression methods – becoming able to overcome CFS meant masking was no longer effective, and vice versa – providing strong evidence that the same (or at least overlapping) neural mechanisms underlie these forms of suppression. Suppression efficacy cannot, therefore, be

assumed to remain stable over time; this has methodological implications for unconscious perception studies. The important theoretical implication regards the presence of generalized plasticity in a mechanism that enhances the representation of suppressed stimuli. This raises new questions regarding the neural locus of this plasticity, the extent to which different methods of suppression use the same neural infrastructure, and what distinguishes learners from non-learners.

The development of bodily self-consciousness: Responses to the Full Body Illusion in childhood

Jane E. Aspell [1], Dorothy Cowie [2], Aisling McKenna [3], Andrew J. Bremner [3]

[1] Department of Psychology, Anglia Ruskin University, Cambridge, UK, [2] Department of Psychology, Durham University, Durham, UK, [3] Department of Psychology, Goldsmiths College, University of London, London, UK.

There is growing evidence – much of it based on data from body illusions - that the brain basis of self-consciousness is underpinned by the integration of multisensory bodily information. The full body illusion (FBI) – in which participants self-identify with a virtual body and show a drift in self-location towards the body - has been replicated many times in adults. In the current study we present the first data on responses to the FBI in children, to examine how bodily self-consciousness develops over childhood. We tested three age groups of children: 6 to 7 year-olds (n=28); 8 to 9 year-olds (n=21); 10 to 11 year-olds (n=19), and a group of adults (n=31; mean age of 27 years). Participants were fitted with a head-mounted-display (HMD) connected to a video camera placed 2 metres behind them, enabling them to view themselves from behind. In the synchronous condition (SC), participants were stroked for 2 minutes on their back by a long stick and viewed this stroking on their 'virtual body' in real-time via the HMD. In the asynchronous condition (AC) they viewed a video recording of stroking and they therefore experienced a visuo-tactile incongruency. The drift in self-location was measured after each stroking condition by the experimenter passively displacing the participant (with closed eyes) backwards by 1.5 metres, and asking them to walk back, unaided, to their original position. (A baseline measure of drift was also acquired before the stroking conditions). Self-identification with and touch referral to the virtual body were measured after the drift, using a questionnaire. Results show that self-identification with the virtual body was significantly stronger in the SC than in the AC in 6-7 year-olds, 10-11 year olds and adults. Referral of touch to the virtual body was significantly greater in the SC than in the AC in 10-11 year-olds and adults only. A significant difference in the drift in self-location between the SC and AC was only found in the adult group. Our data show that the full complement of adult-like responses to the FBI takes some years to develop, however self-identification with the virtual body can be induced even at the earliest ages tested. These results have implications for the understanding of the development of the multisensory body self and also for the use of virtual reality technologies with children.

**CONCURRENT SESSIONS: Friday, July 10th
(14:00 – 15:30)****ATTENTION & CONSCIOUSNESS****Biasing the content of conscious thought with value learning****Sophie Forster [1], Adam Crowther [2]**

[1] School of Psychology, University of Sussex, [2] Institute of Psychiatry, Psychology and Neuroscience, King's College London.

While we may assume that we generally choose what to think about, sometimes a thought may appear to 'pop into our head' unintentionally and distract our attention from its intended focus. This raises the question of what makes a thought particularly salient, and hence likely to capture our attention. To address this question, the present study builds on recent research suggesting that attentional capture by thoughts and external stimuli may share common determinants. Specifically, we tested for the first time the possibility that a known determinant of the "bottom up" salience of external stimuli – reward association – can also increase the salience of a thought. In two experiments, a value training procedure was used to experimentally manipulate whether or not neutral stimuli were associated with monetary reward. During a subsequent thought suppression task, participants were significantly more likely to experience intrusive thoughts about a given stimulus if it had previously been associated with high reward. This effect appeared to reflect a specific impact of value training on the salience of the value-trained stimulus, rather than any more general effect of the training procedure on thought suppression ability. The findings of this study parallel established effects of value training on external attention, and point to the role of a common value-driven mechanism in determining the attentional priority of both external stimuli and mental representations. In addition, we demonstrate a method for experimentally biasing the content of conscious thought.

Neural correlates of conscious perception can be triggered by retrospective attention**Claire Sergent [1], Mariana Babo-Rebelo [2], Nathalie Serafin [1], Valentin Wyart [2], Catherine Tallon-Baudry [2]**

[1] Laboratoire Psychologie de la Perception, Université Paris Descartes / CNRS, [2] Laboratoire de Neurosciences Cognitives, INSERM, Ecole Normale Supérieure.

What are the respective roles of initial sensory processing and later top-down sensory reactivation by the attentional system in the mechanisms of conscious perception? In previous behavioral studies we have shown that changing attention after the presentation of a single stimulus at threshold can still influence whether we consciously perceive this past stimulus or not, a phenomenon we called "retro-perception" (Sergent et al., Current Biology 2013). Using MEG, we investigated the neurophysiological basis of this interaction between post-cued attention and conscious perception. On each trial a single target Gabor patch at threshold contrast was presented to the left or to the right of fixation. Either before or after the target, a symbolic auditory cue biased subjects' attention towards the probable side of the target. Behavior during MEG recording replicated our previous results: post-cues presented 400 or even 900 ms after target still improved orientation and detection d-primes. When the cue was presented before the target, conscious perception of the target was related to an initial waveform around 200 ms post-target and a later, more sustained waveform around 500 ms post-target. In source reconstruction (using the subjects' individual structural MRI and fMRI retinotopic mapping), these two phases were clearly linked to a first wave of activity in visual cortex that was stronger for seen than unseen targets (although physical stimulation was identical in both cases), and a second "reactivation" of the visual cortex occurring exclusively for "seen" targets. In trials with post-cued attention, the first waveform remained time-locked to the target, but the second phase was found to be time locked to retrospective attention induced by the auditory cue, 400 or 900 ms post-target. Source reconstruction suggested that

retrospective attention triggered a late reactivation of the visual cortex and that this reactivation strongly interacted with subjects' conscious perception. Since we used symbolic auditory cues, this visual reactivation was necessarily mediated by top-down influence from fronto-parietal areas, as confirmed in the sources. These results suggest that sensory reactivation by attention plays a central role in the neural mechanisms of conscious perception. They also challenge our intuitions by showing a high flexibility in the timing of conscious perception and associated neural events relative to timing in the external world.

Barack Obama Blindness (BOB): Absence of visual awareness to a single object

Marjan Persuh [1], Robert D. Melara [2]

[1] Department of Social Sciences and Human Services, Borough of Manhattan Community College, City University of New York, [2] Department of Psychology, City College, City University of New York.

Previous experiments have shown that people miss a visible but unexpected object in a field of other objects when engaged in an attentionally demanding task. Yet no previous experiment has examined the extreme case of blindness to a single object appearing alone in the visual field. In two experiments we evaluated whether a perceiver's prior expectations could alone obliterate his or her awareness of a salient visual stimulus. To establish expectancy, observers first made a demanding visual discrimination on each of three baseline trials. Then, on a fourth, critical trial, a single, salient and highly visible object appeared in full view at the center of the visual field and in the absence of any competing visual input or competing task demands. Surprisingly, fully half of the participants were unaware of the solitary object in front of their eyes. Yet in a control condition these same observers easily detected the same object in the same screen position.

Fragile visual memory suggest a dissociation between attention and consciousness

Yair Pinto [1,2], Annelinde Vandenbroucke [3], Victor Lamme [2], Anil Seth [1], Ilja Sligte [2]

[1] Sackler Centre for Consciousness Science, University of Sussex, Brighton, UK, [2] University of Amsterdam, Netherlands, [3] University of California, Berkeley, CA, USA.

An influential idea in consciousness science is that conscious contents are selected through attentional processes and are then made available to other cognitive processes, including metacognitive processes, by being held within working memory. On global workspace theory, for example, it is the continuous process of selection and broadcast that determines conscious status. Views like these are challenged by data showing that integrative and metacognitive processing can take place in the absence of attentional selection. Here, we report a series of studies on so-called "fragile memory" – visual memory before visual interference - which is a perceptually richer though less stable form of memory than working memory. Importantly, fragile memory – in the visual domain – is independent of spatial attention, yet our data show that its contents are available for metacognitive processing and integrate binocular information. In two sets of experiments we employed a cued change detection paradigm. In the first set of experiments, we precued a spatial location with high validity, to induce participants to focus their attention at this location. As expected, participants' working memory for uncued locations was nearly completely erased. However, fragile memory remained largely unaffected, suggesting independence from spatial attention. Moreover, even in this unattended situation, participants still had accurate metacognition regarding their fragile memory performance. In a second set of experiments we presented memory displays either binocularly or monocularly. In the binocular condition, the display items were only visible after binocular integration. In both conditions fragile memory remained nearly twice as rich as working memory. Also, when we presented masks that are known to erase fragile memory, we found that the effectiveness of these masks was independent of ocular identity. That is, if the memory display was presented to one eye, but the mask to another, the mask was equally effective. These data show that fragile memory contents integrate binocular information. Altogether, our findings delineate a form of visual memory which is perceptually rich, independent of spatial attention, metacognitively accurate and based on binocular signals. These results therefore pose a challenge to

theories of consciousness which associate integrated conscious contents specifically with attention and working memory.

BODY OWNERSHIP

Introspection as inference: adaptive gain control, metacognition, and embodied self-awareness

Micah Allen [1, 2], J. Calum Glen [2], Darya Frank [2], Geraint Rees [1, 2]

[1] The Wellcome Trust Centre for Neuroimaging, University College London, 12 Queen Square, London WC1N 3BG, UK, [2] Institute of Cognitive Neuroscience, University College London, 17 Queen Square, London WC1N 3AR, UK.

The ability to monitor, control, and report one's experiences is a core human ability. Recent advances in the application of signal-detection theory to metacognitive introspection highlight the role of prefrontal cortex in generating representations of subjective confidence during perceptual decisions (Lau and Fleming, 2014). While these approaches reveal deep individual differences in introspective ability (Fleming et al, 2012), thus far they have largely failed to account for the multimodal, dynamic, and embodied nature of conscious awareness. This oversight is fundamental to the signal-theoretic approach, which models experience reports as the product of a single-channel, feedforward process, rather than as the result of a higher order inference or belief integrating multimodal information with prior experience. In this talk I will present a novel model of introspection-as-inference, grounded in embodied predictive coding, that instead positions metacognition as the inversion of a high level generative “self-model” predicting the joint probability of external sensory causes and their internal bodily responses. In support of this framework, I will present data from a series of 5 psychophysical experiments investigating the influence of sensory and interoceptive gain on perceptual and metacognitive decision making. To do so, we developed a novel paradigm to orthogonally manipulate both the mean and variance (i.e. inverse-precision) of sensory signals. Across five experiments we demonstrate a consistent impact of sensory variance on subjective confidence and metacognitive bias, confirming that confidence is scaled by both the mean and precision of sensory inputs as expected under a Bayesian framework (Friston, 2014). Crucially, we show type-II criterion greatly exaggerates fluctuations in sensory variance, rendering confidence judgements for variable stimuli more conservative even in the face of equal performance. At extreme levels, this leads to a form of ‘healthy brain blindsight’, where subjective awareness is greatly degraded in spite of preserved signal detection. Finally we show that variance-evoked pupil dilation, an index of neural gain and bodily arousal, significantly predicts the extent of this conservative bias. Collectively these results indicate that metacognition is a supra-modal inference integrating both exteroceptive and interoceptive gain to regulate the salience of perception and action.

Body ownership and the four-hand illusion

Wen-Yeo Chen [1], Hsu-Chia Huang [1], Yen-Tung Lee [2], Sufen Chen [3], Caleb Liang [1,2]

[1] Graduate Institute of Brain and Mind Sciences, College of Medicine, National Taiwan University, [2] Department of Philosophy, National Taiwan University, [3] Graduate Institute of Digital Learning and Education National Taiwan University of Science, Taipei, Taiwan.

How flexible is our sense of body ownership? Is it possible that one may have the illusory experience of owning four hands? In this interdisciplinary study, a head mounted display (HMD) was used that the participant adopted the experimenter's 1PP as if it was his/her own 1PP. Sitting face to face, the participant saw four hands—the experimenter's two hands from the adopted 1PP and the subject's own hands in the opposite direction (180°) from the adopted 3PP—being stroked synchronously or asynchronously. Here are our findings: (1) Compared with the asynchronous conditions, the synchronous condition induced a variant of the rubber hand illusion ($p=0.002$) (RHI; Botvinick & Cohen, 1998; Tsakiris & Haggard, 2005)...

'Myness' isn't Positive

Kranti Saran [1,2]

[1] Assistant Professor, Ashoka University, [2] Research Associate, Harvard University.

In virtue of what do we experience our bodies as our own? Deflationists like Martin (1992, 1995) and Bermudez (2011, 2015) argue that there is no distinctive positive quale of ownership or 'myness', while de Vignemont (2007, 2013) argues that there is a positive phenomenology of 'myness'. I sharpen the question by distinguishing differing conceptions of ownership too often conflated in the literature, and by distinguishing ownership of sensations from that of particular limbs, and from the body as a whole. I argue in favour of a novel deflationist position. Unlike Martin, my position does not rest on the claim that for every bodily sensation B that subject S has, it seems to S that B is located on or within S's body, from which it follows that no sensation could lack the quality of feeling to be located within S's body nor could it have the positive quality of feeling to be located outside S's body. Unlike Bermudez, my position does not depend on a putative dilemma, inspired by Anscombe, according to which either bodily sensations are too general and vague to be the epistemic basis of bodily ownership or they are not describable independently of judgments of ownership and so could not ground them. On the view I defend, ownership is a product of a cognitively structured apprehension of bodily sensations. I defend my deflationist position against the challenges posed by de Vignemont (2013) for deflationists: belief-independent illusions of ownership and bodily sensations with no sense of ownership.

My body as mine: bodily awareness and nonconceptual self-consciousness

Carlota Serrahima [1]

[1] LOGOS - Universidad de Barcelona

This paper revolves around the experience of body ownership in bodily sensations. Its aim is to critically assess the prospects of the deflationist approach to such experience. Bodily sensations typically are mental states suitable to ground *de se* judgments: subjects with a conceptual system or language would express such states by qualifying their content with a first person indexical. More specifically, when undergoing a bodily sensation one is typically aware of qualities that seemingly qualify a body that one takes to be one's own body. In the literature, this is sometimes formulated by saying that subjects "feel ownership" for the body conveyed to them by the sensation. This being so, I am interested in figuring out what psychological processes or phenomenal features involved in bodily sensations make them suitable for first-personal proprioceptive judgments. As an answer to this question, some defend a deflationist position (i.e. Martin; Bermúdez): an analysis of the sensory content of bodily sensations, which can be specified in terms of localized qualities, is sufficient to account for their self-referential expression. Starting from the relatively uncontroversial assumption that the content of bodily sensations is nonconceptual in nature, I shall notice that, if one intends to account for the first-personal component of bodily sensations by appealing only to their sensory content, one is advocating for some sort of nonconceptual sensory representation of oneself as oneself. However, I shall argue, there are some major difficulties in putting forward a satisfactory proposal along these lines. Very briefly put, my argument will run as follows: if, as deflationism requires, we can only rely on the sensory content of bodily sensations to account for one's awareness of oneself as oneself when undergoing them, then it seems that some sort of nonconceptual equivalent to the first-person concept, with similar characteristics, should be embedded into such content. But (i) it is not clear why something along these lines would at all be different from a first-person concept proper, and, more importantly, (ii) in some occasions, in bodily sensations self-specificity and body ownership don't go hand in hand (as is the case of somatoparaphrenic patients); however, if a nonconceptual equivalent to the first-person concept were to be deployed in sensations, a representation of the own body should always be of the own body as one's own.

MULTISENSORY INTEGRATION

Unconscious cross-modal binding: Implications for integration theories of consciousness

Ron Chrisley [1,2,3,4], Ryan Scott [5,2,3,4], Jason Samaha [6,7], Zoltan Dienes [5,2,3,4]

[1] School of Engineering and Informatics, [2] Centre for Cognitive Science, [3] Sackler Centre for Consciousness Science, [4] University of Sussex, [5] School of Psychology, [6] Department of Psychology, [7] University of Wisconsin.

Several leading theories of consciousness, including Global Workspace Theory, claim that a central function of consciousness is to permit the integration of information from different functional regions, such as different sense modalities: call such theories of consciousness “integration theories”. A presupposition of integration theories is that unconscious processing cannot achieve this kind of integration, as witnessed by such claims as “unconscious input processing is limited to sensory regions”, and “consciousness is needed to integrate multiple sensory inputs” (Baars 2002, p 47-48). I report on work by our team that set out to determine whether associative learning can take place without conscious perception of the stimuli and whether this can be achieved where stimuli to be associated are presented in different modalities. Employing a new paradigm, it was demonstrated over four experiments that pairs of stimuli presented subliminally were associated, as evidenced by the ability of one stimulus to prime classification of the other. Experiment 1 presented stimuli auditorily, Experiment 2 visually, and Experiment 3 presented one of the paired words auditorily and the other word visually. Experiment 4 generalised this paradigm to non-linguistic stimuli (auditory and visual). All four experiments found the same significant inhibitory priming effect with concordant test pairs associated with slower classification judgements. Thus it appears that, contrary to integration theories, unconscious inputs from distinct sensory modalities can be integrated. After reviewing the background and the above experimental findings, I will assess the impact of the findings on integration theories. In particular, I will consider how integrationist theories might be modified to accommodate these findings. For example, one might abandon the idea that consciousness is required for integration tout court, and instead claim that it is required for integrated information to be deployed in a flexible way, e.g. that spans longer time scales, can potentially manifest itself in a wide range of effects depending on the needs of the subject (e.g., not just reaction time), or is generally under the executive control of the subject.

Multimodal mental imagery, synesthesia and cognitive penetration

Bence Nanay [1,2]

[1] Centre for Philosophical Psychology, University of Antwerp, [2] University of Cambridge.

I hear footsteps from the direction of the stairs. But I don't see who is coming up the stairs. I attribute properties auditorily to a multimodal sensory individual, but then the question is: how do I represent the non-auditory parts of this multimodal sensory individual? More generally, how do we represent those parts of the multimodal sensory individual that we receive no sensory stimulation from? Departing from a recent proposal (Nanay 2010, Briscoe 2011) about the importance of unimodal mental imagery in understanding how we represent those parts of the unimodal sensory individual that we receive no sensory stimulation from (in the visual sense modality: the occluded parts of perceived objects), I give a parallel argument about the multimodal case: when I hear the footsteps, I fill in the visual (and maybe the olfactory) parts of the multimodal sensory individual by means of multimodal mental imagery. This multimodal mental imagery is normally unconscious, normally involuntary and localizes its object in one's egocentric space. And this multimodal mental imagery, like mental imagery in general, is very much sensitive to our higher order mental states, beliefs and expectations. Two important implications: About synesthesia: There are some sensory individuals that are not normally accompanied by multimodal mental imagery, for example, seeing a rainbow or seeing a number. The complexity of the multimodal mental imagery of a sensory individual tends to correspond to the number of different sense modalities it is normally perceived with. We normally both see and hear people talking and, as a result, when only seeing a face talking (on TV with the sound muted, for example), we fill in the auditory properties by multimodal mental imagery (Calvert et al., 1997; Pekkola et al., 2005, Spence and Deroy

forthcoming). But we normally only see rainbows, don't hear or smell them – the visual perception is not accompanied by multimodal mental imagery. I argue that synesthesia could be analyzed as the triggering of multimodal mental imagery in cases where no previous exposure would justify it. About cognitive penetration: If the representation of most features of perceived objects is by means of multimodal mental imagery and if mental imagery depends on our beliefs and expectations, then we get an argument for the cognitive penetration of perception that is not susceptible to some recent worries about cognitive penetration (e.g., Firestone and Scholl 2014).

Training Induced Synaesthesia-Like Experiences Result in Enhanced Cortical Excitability

David Schwartzman [1,2], Nicolas Rothen [1,3], Daniel Bor [1,2], Anil Seth [1,2]

[1] Sackler Centre for Consciousness Science, University of Sussex, United Kingdom, [2] Department of Informatics, University of Sussex, United Kingdom, [3] Department of Psychology, University of Sussex, United Kingdom.

Synaesthesia is a condition offering unique insights into how conscious experiences arise. While synaesthesia is widely considered a congenital condition, recent evidence from our laboratory suggests that overtraining of letter-colour associations in a non-synaesthetic population can induce synaesthetic-like conscious experiences, as well as behavioural markers of genuine synaesthetes (Bor et al., 2014). These findings support the view that repeated exposure to multimodal associations at key developmental stages may be a significant factor in the development of grapheme-colour synaesthesia. However, it remains unclear whether the synaesthesia-like experiences produced by overtraining result in similar enhanced modality-specific perceptual processing, as observed in grapheme-colour synaesthesia (Barnett et al., 2008). Using an intensive five week cognitive training battery that associated thirteen graphemes with thirteen colours, we investigated using combined behavioural, electroencephalogram (EEG) and transcranial magnetic stimulation (TMS) studies whether overtraining of grapheme-colour associations leads not only to behavioural effects and additional synaesthetic-like experiences, but also to increases in the excitability and modality specific enhanced processing within primary visual cortex. Post-training interviews found that all subjects described perceptual-like experiences closely mirroring those of grapheme-colour synaesthetes. Moreover, subjects exhibited many typical markers of synaesthesia after the training, as measured by consistency tests and Stroop interference. Crucially, we show, for the first time, that overtraining of grapheme-colour associations also results in lowered phosphene thresholds as measured by TMS, indicating increased cortical excitability, and enhancement of specific visual evoked potential (VEP) components (to untrained checkerboard stimuli), indicating increased perceptual sensitivity. These results provide a concrete link between training-dependent changes in conscious phenomenology and in neurophysiological properties. They suggest that the synaesthetic-like experiences produced by overtraining may be driven by enhanced cortical excitability and increased perceptual sensitivity of the primary visual cortex, reflecting the cortical profile seen in genuine grapheme-colour synaesthesia. Our results also further emphasise a previously unsuspected potential for new learning to shape perceptual experience in adults.

The reach of phenomenal consciousness and synesthesia

Aleksandra Mroczko-Wasowicz [1]

[1] Institute of Philosophy of Mind and Cognition, National Yang-Ming University Taipei, Taiwan.

Currently, little is known about how synesthesia develops and which aspects of synesthetic experiences can be acquired through a learning process. Here, I review the increasing evidence for the role of semantic representations in the induction of synesthesia, and argue for the thesis that synesthetic experiences can be developed and modified by high-level contents. That is, semantic mechanisms associate concepts with perception-like experiences—and these associations occur in an extraordinary way. This phenomenon can be referred to as “higher” synesthesia. The present analysis suggests that synesthesia develops during childhood, is capable of being enriched further throughout the synesthetes' lifetime, and embracing a variety of phenomenology. For a deeper understanding of the origin and nature

of synesthesia I propose to focus future research on two aspects: (i) the similarities between synesthesia and ordinary phenomenal experiences involving the representation of high-level categories; and (ii) the tight entanglement of perception, cognition and the conceptualization of the world. Importantly, an explanation of how we get to generate experiences, synesthetic or not, may have to entail an explanation of how semantic networks are formed in general and what their role is in the ability to be conscious of ourselves and the surrounding world. By highlighting individual differences and the course of early development of conscious perception, synesthesia research can inform consciousness studies. Different epistemic styles (cognitive/perceptual) developed by synesthetes demonstrate how non-sensory information meshes with sensory information. Such kind of binding may be seen as a prerequisite of phenomenal admissibility of high-level cognitive properties in the contents of perceptual consciousness. This may shed light on the spectrum of synesthetic phenomena with a common etiology, the roots of sensory and non-sensory phenomenology in general, as well as the debate on the admissible contents of phenomenal consciousness.

POSTER SESSIONS

Wednesday, July 8th
(16:00 – 17:30)

ACTION & VOLITION - I

P001 - Using high-gamma oscillations to track the neural dynamics of volitional action

Ondřej Bečev [1,2,3], Milan Brázdil [2], Martin Lamoš [2], Radek Mareček [2]

[1] Masaryk University, Faculty of Medicine, CZECH REPUBLIC, [2] Central European Institute of Technology, Behavioral and Social Neuroscience, CZECH REPUBLIC, [3] Faculty of Humanities, Charles University in Prague, CZECH REPUBLIC.

The research in recent years has shown that the process of forming the motor intention in the brain is more than just an atomic moment, but has the complex internal structure of its own. The intention to act doesn't rise at once, but it comes through multiple stages. The current evidence suggests that each of the stages of the action planning specifies certain aspect of the action – we recognize the what, when and whether phases. Our study High-gamma oscillations (~40–200Hz) have been shown to be reliable and specific marker of local neural activity that outperforms classical EEG and fMRI markers both in spatial and temporal resolution. Compared to other EEG rhythms, high-gamma also corresponds better to fMRI hemodynamic response. This rhythm is also known to be spatially more focal and more task specific, making it a good choice for application of the source reconstruction software. Our study uses an unique high-density EEG technology (hdEEG) that combines very good temporal resolution with good source localization. This allows to overcome major limitations of the older studies and to create a reliable and precise model of the brain dynamics responsible for motor intentions and motor agency. In contrast to previous studies hdEEG allows to observe the fine-grained temporal aspect. The greatest advantage, however, is the potential in source localization, greatly beyond the capabilities of classical EEG. The source localization is performed using subjects' anatomical MRI scans.

Goal of the study. Our study aims at tracking the neural dynamics of free voluntary action using the high-gamma oscillations. We believe that the specific features of high-gamma rhythm together with using high-resolution EEG recording will offer an unique tool for tracking the temporal and spatial aspects of brain processes underlying a volitional motoric action. As a secondary goal, our results will be compared to a more classical analysis of the same data, based on Libet's Readiness Potential. We hypothesize, that high-gamma oscillations in IPL (infero-parietal sulcus) correspond better with the moment of conscious experience of intention (Libet's W) than conventional Readiness Potential.

P002 - Sleep Deprivation Produces Feelings of Vicarious Agency

Nicholas Hon [1], Jia-Hou Poh [2]

[1] National University of Singapore, [2] Duke-NUS Graduate Medical School

A number of important self-related psychological constructs and behaviours rely on the fundamental ability to accurately sense either one's agency or lack of agency in some action or outcome. In the normal population, such agency judgments are typically studied in individuals who are well-rested and mentally fresh; that is, while they are in a state of rested wakefulness. In the frenetically-paced real world, however, agency judgments often need to be made while one is in a less optimal state. Here, we studied the effect of being in one such non-optimal state - when sleep-deprived - on explicit judgments of agency. We found that sleep deprivation produced an experience of "vicarious agency": Compared with when participants were in a state of rested wakefulness, 24 hrs of total sleep deprivation elevated agency ratings on trials designed to produce a strong sense of non-agency. We interpret these results in relation to well-known deleterious effects of sleep deprivation on brain function and, in

particular, mismatch processing. These findings provide the first evidence that explicit agency processing can be affected by simple disruptions to normal biological rhythms. Additionally, they demonstrate that, beyond general cognitive functions, sleep deprivation can reliably impact personally-relevant cognitions like those relating to the self.

P003 - The timing of intentions and sense of agency in hypnosis and meditation

Peter Lush [1,2], Jim Parkinson [1,2], Peter Naish, [2], Zoltan Dienes [1,2].

[1] School of Psychology, Pevensey Building, University of Sussex, Falmer, BN1 9RH, UK, [2] Sackler Centre for Consciousness Science, University of Sussex, Falmer, BN1 9RH, UK.

Higher order thought (HOT) theories of consciousness claim that a 1st order state becomes conscious in virtue of a HOT that is about it. According to the cold control theory of hypnosis, hypnotic response consists of intending to perform a motor or cognitive action while having the inaccurate higher order thought that one is not intending the action. We conjecture that highly hypnotisable people may take longer to develop accurate HOTs of intending in general, and this delay makes it easier to be unaware of intentions when it is strategically desired (i.e. makes it easier to respond hypnotically). By contrast to hypnotic responding, mindfulness meditation involves cultivating awareness of mental states, including intentions. Thus, practice in meditation may lead to tighter coupling between HOTs and 1st order states of intending. In two studies, we tested these hypotheses in hypnotisable groups and experienced meditators using a Libet clock task in which people reported when they were aware of their intentions. We found that high hypnotisable people reported a later time of intending to move (W), and meditators an earlier time of intention, than medium hypnotisables. In a third study, we used intentional binding to investigate whether these differences in explicit, metacognitive judgements of agency are related to differences in implicit feelings of agency. Intentional binding refers to the compressed time interval between an action and its outcome, which consists of a backwards shift of the report of outcome time and a forward shift of reported action time. We found high and low hypnotisables had no difference in intentional binding, consistent with a full dissociation between explicit judgements and implicit feelings of agency. Meditators did not differ from non-meditators in the action component of binding, but showed a greater backward shift of outcome timing. This finding cannot be attributable to attention, and suggests meditation is related to stronger predictions of action outcomes. The results we report for hypnotisable groups are consistent with the cold control theory of hypnosis and suggest that hypnosis may provide a way of manipulating higher order thoughts of intending and that explicit judgements of agency do not depend upon implicit feelings of agency. The findings reported for meditators suggest that mindfulness is related to a greater coupling of judgements of agency to 1st order intentions and thus is opposite to hypnotic response.

P004 - Cue integration in the sense of agency – the role of prior causal belief and sensorimotor prediction in intentional binding

Bartosz Majchrowicz [1], Michał Wierchoń [1]

[1] Consciousness Lab, Institute of Psychology, Jagiellonian University, Krakow, Poland.

Sense of agency (SoA) refers to a subjective feeling of being an author of one's own actions and their effects, which may also be accompanied by an explicit judgment. This phenomenon may be described within the cue integration model, which represents the more general Bayesian models of cognition. In this model, SoA depends on various, interacting kinds of cues (prior, predictive & inferential), which are weighted and integrated following Bayesian rules. The model is capable to explain not only regular SoA, but also various SoA errors observable in both health and disease. In our study, we took a closer look at the role of prior causal belief and its influence on both explicit and implicit levels of SoA. A version of Libet's clock paradigm implementing a measurement of temporal attraction of actions and their effects (intentional binding effect; IB), as well as questionnaires were used to assess SoA on both levels. Participants first underwent baseline and associative phases, which allowed measuring standard IB and also let participants associatively learn that their actions (key presses) always led to specific effects (tones). Then, via instruction manipulation, we induced specific bias in experimental group:

participants were informed that now their actions would sometimes produce different, surprising effects. In experimental phase, unpredictable oddball tones were presented with more frequent tones identical to those learnt in the previous phase. We hypothesized that (1) induced bias should lead to higher weighting of prior information and outweigh less reliable predictions about actions' consequences. Accordingly, SoA over unexpected outcomes (oddballs) should be higher in experimental than in control group. We also assumed that (2) in the course of the experiment, prior regarding action-effect association should also be updated, leading to increase of SoA in the later oddball trials of control group. Results of the experiment will be presented at the conference. Both hypotheses are tested using explicit and implicit measures (IB and questionnaires), leading to further clarifications about relation between these levels of agency. Results may validate the integrative account of SoA adopted here, as well as add further evidence suggesting that cognitive system's functioning may be described in terms of weighting and integration of different sensorimotor and cognitive cues following Bayesian rules, consistent also with the predictive coding framework.

P005 - Arrows and emotion: Two methods of subliminally priming volitional decisions to act

Jim Parkinson [1,2], Sarah N. Garfinkel [1,3], Patrick Haggard [5], Zoltan Dienes [1,2], Anil K. Seth [1,4]

[1] Sackler Centre for Consciousness Science, University of Sussex, [2] School of Psychology, University of Sussex, [3] Brighton and Sussex Medical School, [4] Department of Informatics, University of Sussex, [5] Institute of Cognitive Neuroscience, UCL.

Making conscious decisions about whether to perform an action or not is a fundamental aspect of the human life. Can such instances of intentional self-control be manipulated by non-conscious information? Here we present behavioural and EEG data describing two contrasting methods by which volitional self-control is manipulated by subliminal priming techniques. Both experiments utilised a novel version of the Go/NoGo paradigm: Participants made speeded, single-hand button responses to Go targets (50% of trials). Rare NoGo targets (16%) indicated that the button press must be withheld. Crucially, a third target-type indicated that they could choose to make the button press or not, termed Intentional Go and NoGo trials, as compared to their Reactive (exogenously elicited) counterparts. In one experiment using arrow stimuli as targets, backwards-masked subliminal prime arrows were presented prior to targets. Primes classed as facilitatory speeded both Intentional and Reactive Go response times (RTs) whereas inhibitory primes slowed them. Importantly, subliminal prime arrows also manipulated Intentional choice rates as well as response times, with facilitatory primes increasing the likelihood of acting, as compared to inhibitory primes. Event-related potential (ERP) analysis of EEG data revealed that prime stimuli modulated the amplitude of the N2 ERP component associated with motor inhibition and self-control. This suggests that stimulus-response based modulation of motor activity might account for priming effects on both Reactive and Intentional RTs. This might also be a candidate mechanism for subliminal priming effects on volitional choice rate. A second set of experiments attempted to manipulate volitional choice using more natural, meaningful stimuli, namely subliminally presented emotional faces. Here, angry faces made participants less likely to make a volitional action compared to neutral faces, but in contrast to arrow primes, no effects of face primes were seen on Reactive or Intentional Go response times. Angry primes moreover did not modulate N2 ERP components, but did modulate frontal-central theta activity that is associated with aspects of cognitive control. These results suggest that the influence of emotional face priming on volition action resides at a more cognitive, than motoric-response level. To further disambiguate these possibilities we will present data from a new study that combines these two types of volitional choice priming.

P006 - Choice-predictive brain signals across motor and abstract decisions

Chun Siong Soon [1], Po-Jang (Brown) Hsieh [1]

[1] Duke-NUS Graduate Medical School.

Brain activity patterns occurring before a decision is consciously made have been found to be predictive of the decision outcome and timing. For both motor and abstract decisions, such predictive signals can be detected in frontal and parietal regions, but it remains unclear whether they involve the same cortical networks. Here we directly assessed within the same individuals whether overlapping cortical regions are involved in both types of decisions. The same individuals made binary motor (to press a left or right button) and abstract (to perform addition or subtraction) decisions in separate experimental runs, while functional brain images were acquired. Cortical searchlight-based pattern classification was first performed independently for each decision context to identify choice-predictive regions. We further evaluated whether predictive neural patterns in motor decisions were also informative about abstract decisions, and vice versa. Our findings suggest that decision networks coding for different choices within a decision context may flexibly encode the choices of a different decision context.

P007 - An ERP Study on Sense of Agency and Perception of Delayed Auditory Feedback of Self-movement

Koichi TOIDA [1,2], Kanako UENO [1,2], Sotaro SHIMADA [2,3]

[1] Department of Architecture, School of Science and Technology, Meiji University, Kanagawa, Japan, [2] CREST, Japan Science and Technology Agency, Saitama, Japan [3], Department of Electronics and Bioinformatics, School of Science and Technology, Meiji University, Kanagawa, Japan.

Temporal contingency between self-movement and the associated sensory feedback is crucial to perceive the sense of agency. Here we investigated the event-related potential (ERP) components elicited by the temporal discrepancy between the self-movement and its auditory feedback. With an oddball paradigm, the deviant stimulus was delivered with a certain delay from the participant's mouse-click, while the standard stimulus was delivered without delay. We introduced four delay conditions (100, 200, 300, and 400ms), and the control condition (standard stimulus only). Each condition was conducted in a separate session. Sixteen participants were participated and instructed to silently count the number of trials they could detect the auditory feedback delay. At the same time, participants were asked to fill out the questionnaire regarding the sense of agency with a 7-rating scale for each condition after the session: "Did you feel like the sound was made by yourself?" (Q1), "Was the sound elicited in the way just as you thought?" (Q2). The behavioral data (number count) showed that the average number that participants counted the deviant stimulus was increased monotonically from the control condition to the 300ms- and 400ms-delayed conditions. Similarly, the sense of agency was attenuated as the delay lengthened: the agency score was significantly weaker in the delay conditions than in the control condition for Q1, and was weaker in the 200ms-, 300ms- and 400ms-delayed conditions than in the control and 100ms-delayed conditions for Q2. As for the ERP data, we found that N300 was robustly elicited by the delayed auditory feedback...

P008 - Do Patients with Obsessive-Compulsive Disorder Have Free Will ?

Karen Yan [1], Allen Y. Houngh [2]

[1] Institute of Philosophy of Mind and Cognition, National Yang-Ming University.

Patients with obsessive-compulsive disorder (OCD) often have recurring obsessive thoughts and repetitive compulsive behaviors in response to these thoughts. They often have an overwhelming urge to wash their hands, to count their footsteps, or to do some other actions. They usually indicate that they wish to get rid of those repetitive behaviors, but cannot stop themselves from doing them. In view of this condition, it seems natural to think that OCD patients have no free will with respect to their compulsive behaviors, because they are not behaving according to their will. By contrast, OCD patients do have

free will if one evaluates the compulsive behaviors of OCD patients according to the compatibilists' definitions of free will. The core idea of these different definitions is that if one has the possibility to choose or the relevant capacity to choose, then one still has free will in this sense. OCD patients may fail in executing the desirable behaviors, but they still have the possibility or the capacity to choose what is desirable. In this paper, I argue that these two claims about OCD patients are not contradictory if one brings in a further factor—the point of view by which a claim is asserted. That is, one claim is asserted from a first-person point of view and the other claim is asserted from a third-person point of view. I will show that the conditions for evaluating the truth of the two claims about OCD patients are different and the two claims are not contradictory.

ATTENTION

P009 - Does attention shape the graduality of visual consciousness? Evidence from an RSVP task

Anna Anzulewicz [1], Dariusz Asanowicz [1], & Michal Wierzhon [1]

[1] Consciousness Lab, Institute of Psychology, Jagiellonian University, Krakow, Poland.

There is a disagreement over whether the transition from pre-conscious to conscious vision has a gradual or a discontinuous (all-or-none) character. Here, we put forward an idea that temporal attentional selection may be one of the factors shaping the temporal dynamics of this transition. Based on the Boost & Bounce theory of temporal attention, we have suggested that the strength of attentional selection may modulate graduality of the transition in such a way that strong attentional selection of one target stimulus decreases graduality of conscious perception of the subsequent target stimulus. A rapid serial visual presentation (RSVP) task was used to test this idea, and the attentional blink effect was measured as an index of temporal attention. Participants identified two targets embedded in the RSVP stream, T1 and T2. To manipulate the strength of attentional selection, we used three colors of T1, black, red, and white, that differed in terms of similarity to the color of T2 and the distractors (light grey). In line with the Boost & Bounce theory, the attentional engagement in selection is supposed to be stronger when the difference between colors is small, and weaker when the difference is more pronounced. After each trial, participants identified both targets, and rated the visibility of the second target (T2) on the 4-point perceptual awareness (PAS) scale. The results showed that the attentional blink was the strongest when white T1 was presented, significantly smaller for black T1, and the weakest in case of red T1. This indicates that the magnitude of the blink was indeed related to the degree of engagement of attention in T1 selection in such a way that stronger engagement caused greater blink. The visibility ratings were similarly graded in all T1 color conditions. Thus, no evidence has been found to support the proposed hypothesis that the graduality of subjective perception is modulated by the strength of attentional selection. Instead, the results suggest generally gradual character of the transition to conscious vision.

P010 - The relationship between the subjective feeling of control and the objective efficiency of attentional control

Dariusz Asanowicz [1], Marcin Bukowski [1], Anna Marzecová [2], Juan Lupiáñez [3]

[1] Institute of Psychology, Jagiellonian University, Kraków, Poland, [2] Institute of Psychology, University of Leipzig, Leipzig, Germany, [3] Departamento de Psicología Experimental, Universidad de Granada, Granada, Spain.

Two experiments were conducted to explore the effects of subjective lack of control, or uncontrollability, on the efficiency of attentional control. First, the feeling of uncontrollability was induced by unsolvable tasks (Experiment 1) or by tasks with random accuracy feedback (Experiment 2). Next, effects of the uncontrollability experience on the efficiency of four functions of attention, vigilance, alerting, orienting, and executive control, were examined with the modified Attentional Network Test (ANTI-Vigilance). Results of both experiments showed a decreased efficiency of executive attention in participants who experienced control deprivation. Also, detrimental effects on the spatial orienting and vigilance were observed in participants who had been asked to perform unsolvable tasks and did not receive feedback

(Experiment 1). No effects of the uncontrollability on alerting were observed. The results suggest that subjective feeling of control indeed affects the attentional control, but especially the efficiency of executive attention.

P012 - Conscious perception of color and size ensemble statistics requires attention

Molly Jackson-Nielsen [1], Michael Pitts [1]

[1] Reed College, Portland, OR, USA.

The degree to which visual awareness exists outside focal attention is debated. One way to address this question is to present scenes from which ensemble statistics (“gist”) can be extracted while attention is focused on a primary task; gist report is then used as a proxy for perceptual richness. In a recent study, subjects reported the color diversity of a scene while completing a primary Sperling-like visual working memory task (Bronfman et al., 2014, Psychological Science). Color diversity judgments were above chance and letter recall was unaffected by the color task, suggesting rich phenomenal perception outside focal attention. The present experiment tested whether color diversity and an additional ensemble statistic, size diversity, would be perceived in the absence of attention by adding inattention blindness manipulations to Bronfman et al.’s (2014) paradigm. First, subjects completed 7 trials of the working memory task without any mention of color, while the color diversity statistic remained constant. Then, on a critical (8th) trial, a change in color diversity occurred, and subjects were immediately presented three options (the actual display on the critical trial, a display that resembled the first seven trials, and a foil), and were asked to indicate which most resembled what they had just seen. Subjects most often selected the color diversity display from the first 7 trials (58%) while choosing the correct display and the foil display at equivalent rates (22% and 20%, respectively). This result suggests that awareness of color diversity did not occur on a trial-by-trial basis. Next, subjects completed 7 trials of Bronfman et al.’s (2014) dual-task and their basic results replicated. Then, on a second critical trial, a change in size diversity occurred. Subjects were again presented three options and were asked which most resembled what they had just seen. They selected the correct display and the display from the previous 7 trials at equivalent rates (42% and 40%, respectively) even though attention had been spatially dispersed. Finally, participants completed a dual-task with letter identity and size diversity. Working memory capacity was unchanged and size diversity performance was above chance. Overall, these findings suggest that conscious gist perception requires at least a small amount of attention. The gist performance in Bronfman et al. (2014) likely reflects leftover attentional resources rather than cost-free phenomenal awareness.

P013 - Interactive effects of attention and expectation on selection of signals

Anna Marzecová [1,2], Iria SanMiguel [3,4], Andreas Widmann [1], Sonja A. Kotz [5,6], Erich Schröger [1]

[1] Institute of Psychology, University of Leipzig, Leipzig, Germany, [2] International Max Planck Research School on Neuroscience of Communication, Leipzig, Germany, [3] Institute for Brain Cognition and Behavior (IR3C), University of Barcelona, Barcelona, Spain, [4] Brainlab - Cognitive Neuroscience Research Group, Department of Psychiatry and Clinical Psychobiology, University of Barcelona, Barcelona, Spain, [5] Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [6] School of Psychological Sciences, University of Manchester, Manchester, United Kingdom.

Attention and expectation are mechanisms that both enable selective processing of sensory information. Top-down attention prioritises selection of information that is relevant for current goals. Expectation facilitates interpretation of sensory data based on information about prior probability. Although attentional selection often relies on expectation, these two sources of top-down influence seem to operate in a distinct fashion and leave dissociable signatures on neural responses. It remains a challenge to characterise how attention and expectation synergistically influence sensory processing. I will present two event-related potentials (ERPs) experiments that analyse the time-course of attention and expectation effects on processing of visual stimuli, ie. sinusoidal gratings embedded in noise. The first study showed both independent and interactive effects of attention, which was manipulated by trial-by-trial task-relevance cues, and expectation, which was manipulated by probabilistic cues. An

enhanced amplitude of posterior N1 potential (150-190 ms) was observed for attended gratings, while the main effect of expectation was characterised by a broad fronto-central negativity in the later time window (175-220 ms). Unexpected gratings elicited larger negativity than expected ones. As revealed by the interaction between attention and expectation, this effect was magnified in the unattended condition. These results will be contrasted with the outcomes of the second study that investigates the interaction between attention manipulated in a block-wise filtering fashion, and expectation of a specific feature of a grating (its particular orientation). The findings will be discussed within the predictive coding framework.

P014 - Predicted stimuli have increased chance of entering awareness: evidence from the attentional blink paradigm

Erik L. Meijs [1], Sjoerd Manger [2], Heleen A. Slagter [2,3], Floris P. de Lange [4], Simon van Gaal [2,4]

[1] Radboudumc, Donders Institute for Brain, Cognition and Behaviour, Nijmegen, the Netherlands, [2] Department of Psychology, University of Amsterdam, Amsterdam, the Netherlands, [3] Cognitive Science Center Amsterdam, University of Amsterdam, Amsterdam, the Netherlands, [4] Radboud University, Donders Institute for Brain, Cognition and Behaviour, Nijmegen, the Netherlands.

There is substantial evidence for the effect of top-down predictions on perception. Yet, little is known about the relationship between predictions and awareness. Here, this relationship is studied using the attentional blink paradigm. The attentional blink is an impairment in the conscious perception of a target stimulus when it has been rapidly preceded by another target stimulus. We explore whether the likelihood that the second stimulus reaches awareness is altered when its identity is predicted. There are two opposing hypotheses about the influence of predictions on perceptual awareness: 1) conscious access might emerge when predictions are verified so that prediction errors are minimized or 2) conscious access could depend on the violation of current predictions, since novel stimuli may have increased behavioral relevance. Here we will arbitrate between these two possible scenarios. Subjects ($n = 26$) were presented with a rapid stream of letter stimuli (92ms/stimulus) in which they had to detect certain target letters. On most trials the first target (T1: G or H) was followed by a second target (T2: D or K) that would appear with a delay of 2, 4 or 10 stimuli. Crucially, there was a predictive relationship between the two targets. Namely, the T1 (e.g. G) predicted which T2 was likely (60%, e.g. D) or unlikely (20%, e.g. K) to appear. On the 20% remaining trials without a T2 random distractor letter was presented at the T2-timepoint. The subject's task was to indicate the presence/absence of T2 and the identity of T1 and T2. We found that subjects were better at detecting (d-prime) predicted than unpredicted T2 letters, as indicated by the hit rates. Moreover, discrimination ability between the two possible T2 letters was higher for trials with a valid prediction. In conclusion, we show that valid predictions about an upcoming stimulus increase the likelihood that the stimulus is consciously perceived (i.e. helps participants detect a stimulus that is often missed). This may indicate that a prediction validation amplifies the perceptual strength of a stimulus, therefore increasing the likelihood that it crosses the threshold of consciousness.

P015 - Spatial Attention Enhances Neural Responses to Visible but not Invisible Signals

Cooper A. Smout [1], Jason B. Mattingley [1,2]

[1] Queensland Brain Institute, The University of Queensland, Australia, [2] School of Psychology, The University of Queensland, Australia.

Recent theories argue that attention and conscious awareness are distinct and dissociable phenomena. Attention is not a unitary construct, however, and evidence that endogenous spatial attention can dissociate from awareness is relatively limited. Here we present data from a recent experiment that investigated the effect of spatial attention on neural responses to visible and invisible stimuli. Participants ($N = 23$) were presented with two flickering image streams on either side of fixation, each of which contained a visible or invisible signal embedded in dynamic noise. The task was to count the number of

brief contrast decrements in one of the two image streams across each 10s trial. Visibility of the signal was titrated and checked using a two-interval forced-choice detection task. Steady-state visual-evoked potentials (SSVEPs) were computed from electroencephalography (EEG) data at the signal frequencies of interest. Cluster-based permutation analyses revealed a significant neural response to both visible and invisible signals over occipital electrodes. A significantly larger neural response to noise stimuli at the attended location relative to the ignored location confirmed that the attention manipulation was successful. In line with previous findings, spatial attention also increased neural responses to visible signals embedded within noise. Contrary to recent theories, however, spatial attention did not increase neural responses to invisible signals. Post-hoc correlation analyses demonstrated that the weaker neural responses observed for invisible relative to visible signals was not responsible for this null effect. As such, our findings fail to support theories suggesting that endogenous spatial attention can dissociate from conscious awareness.

P016 - Retroactive Attention can Trigger all-or-none Conscious Access to Past Sensory Stimulus

Louis Thibault [1], Patrick Cavanagh [1], Claire Sergent [1]

[1] Laboratoire Psychologie de la Perception, Université Paris-Descartes (UMR 8242)

Cueing attention after the disappearance of visual stimuli biases which items will be remembered best (Sperling, 1960; Sligte et al., 2008). The classical interpretation is that post-cueing influences memory consolidation, but not subjective visual experience. We recently challenged this view by showing that post-cued attention can improve objective and subjective report of a single item at threshold-contrast (Sergent et al., 2013). This suggests that conscious perception itself could be influenced retroactively. Here we tested whether post-cued attention can increase one's chances of seeing a stimulus, or whether it merely allows a more precise recall of its features. Attention was cued to the right or left side of a visual display after a single, threshold-contrast Gabor patch had been presented on the same or opposite side. Subjects then reported the precise orientation of the target by matching the orientation of a probe Gabor. A mixture-model analysis of this continuous measure of angular error allowed estimating both the percentage of guesses and the precision of encoding for non-guesses (Zhang & Luck, 2008). Post-cueing at the correct location had no influence on the precision of the reported angle, but significantly decreased the number of guesses. This suggests that post-cued attention in this instance induces discrete shifts in conscious access to the target percept, rather than preventing a decline in the resolution of remembered features. Using a similar approach in an iconic memory setting with several high-contrast items, we further showed that the performance advantage conferred by post-cueing is attributable not only to the maintained precision of perceptual information (as classically assumed), but also to an increased probability of accessing this information. Taken together, these results suggest that attention can retrospectively trigger conscious access to sensory traces that were not consciously accessed in the first place.

DISORDERS OF SELF-CONSCIOUSNESS

P018 - Causal density analysis of conscious state for intracranial depth electrode recordings of epilepsy patients

Lionel Barnett [1], Michael Schartner [1], Andrea Pigorini [2], Steve Gibbs [3], Simone Sarasso [2], Lino Nobili [3], Marcello Massimini [2], Anil K. Seth [1], Adam B. Barrett [1]

[1] Sackler Centre for Consciousness Science, University of Sussex, Brighton, BN2 9ZP, UK, [2] Department of Clinical Sciences, University of Milan, Milan, 20157, Italy, [3] Centre of Epilepsy Surgery "C. Munari", Niguarda Hospital, Milan, 20162, Italy.

An increasingly popular theoretical idea, is that information processing in conscious brains is associated with a balance between integration, where neural subunits are causally coupled, and segregation, where they are functionally independent. Causal density (CD), a measure of the density of information flow in coupled dynamical systems, has been mooted as a measure of 'neural complexity' reflecting the

dynamical integration/segregation balance: CD will generally be low for both highly coupled and highly decoupled dynamics, and will thus peak in an intermediate regime. Based on Granger causality, CD also has a natural frequency decomposition. In this study, we consider a related 'global CD' (GCD) measure, recently demonstrated to have an intimate relationship with critical behaviour in complex dynamical systems. In contrast to CD, which measures the average information flow between pairs of recorded channels (conditioned on the remaining channels), GCD measures the average information flow from the entire system to individual channels. We investigate the behaviour of GCD in a range of conscious states (wakeful rest, early night non-REM, late night non-REM and REM sleep) in spontaneous intracranial depth electrode recordings from 10 epilepsy patients. For each patient, 18-32 recording channels are selected, distributed over a range of cortical regions. GCD estimates are based on samples of approximately stationary 5 second epochs selected from 10 minute recordings. To ensure that GCD estimates do not simply reflect spectral power, control estimates are obtained from phase-randomised surrogate time series. GCD, both broadband and frequency-decomposed, is compared with several other measures, including an algorithmic complexity measure based on Lempel-Ziv compression, and two variants of Shanahan's 'coalition entropy' (CE): amplitude CE, which measures the variability in the constitution of the set of active channels, and synchrony CE, which measures the variability in the set of synchronous channels. Preliminary results indicate that, across subjects, in the α - and β -bands GCD is in general significantly higher in the waking state, while in the δ -band it is significantly lower.

P019 - Silent but well-connected overnight: Spectral brain network dynamics during recovery from coma

Iulia M. Comsa [1], Stein Silva [2], David K. Menon [2], Tristan A. Bekinschtein [3], Srivas Chennu [1]

[1] Department of Clinical Neurosciences, University of Cambridge, UK, [2] Division of Anaesthesia, University of Cambridge, UK, [3] Department of Psychology, University of Cambridge, UK.

Accurate prognostication of eventual recovery after brain injury is a challenging problem in neurocritical care, with significant medical and ethical implications. Current clinical assessment tools often underestimate the amount of cognitive processing ongoing in unconscious patients. As alternative means of assessment, we analysed changes in brain connectivity over time in a group of 11 acute comatose patients in order to predict their outcome as assessed using the Coma Recover Scale-Revisited two months after severe brain injury. We recorded the overnight electroencephalogram (EEG) in two sessions early after injury and computed graph-theoretical properties of brain networks based on inter-channel coherence. By comparing network dynamics from 8 to 15 days after injury, we found that patients with a better outcome showed an early re-emergence of long-range modules and small-world properties, in particular functional integration over network modules in theta networks. Furthermore, higher variability in both micro- and macroscale properties of delta networks yielded a better prognosis, whereas alpha network properties were least correlated with eventual outcome. We note, however, the case of one patient who showed clear signs of transition from pathological to healthier patterns of connectivity in alpha networks before any signs of behavioural improvement. Despite a poor clinical prognosis after injury, this patient went on to regain full behavioural consciousness within two months. Based on our findings, we suggest that network measures of resting state EEG dynamics can be a valuable clinical tool for bedside assessment of brain injury. By passively assaying brain states, they can inform and mitigate against false negatives in standard behavioural measures and stimulus-driven neuroimaging.

P020 - Neural correlates of response to command recovery in minimally conscious patients

Sarah Wannez * [1], Aurore Thibaut* [1], Marie-Aur lie Bruno [1], Chatelle Camille [1], Claire Bernard [2], Roland Hustinx [2], Pierre Maquet [3], Steve Majerus [4], Steven Laureys [1]

[1] Coma Science Group, Cyclotron Research Centre, University and University Hospital of Li ge, Belgium, [2] Nuclear Medicine Department, University Hospital of Li ge, Belgium, [3] Neurology Department, University Hospital of Li ge, Belgium, [4] Psychology Department - Cognition and Behaviour, University of Li ge, Belgium.

* Both authors contributed equally

Introduction - The minimally conscious state (MCS) can be subcategorized in MCS MINUS (i.e., patients showing non-reflex behaviour such as visual pursuit, localization to pain or to objects or contingent behaviour to emotional stimuli) and MCS PLUS (i.e., the presence of command following) (1). We here aim to assess changes in brain metabolism related to the recovery of language understanding and command following in severely brain damaged patients with chronic MCS.

Method - Brain metabolism was assessed using [18F]-fluorodeoxyglucose-Positrons Emission Tomography (FDG-PET) in 32 patients with chronic MCS MINUS. Four patients were reassessed by FDG-PET after clinical recovery of language comprehension (i.e., evolved to MCS PLUS according to Coma Recovery Scale Revised assessments (2)). Data were pre-processed and analysed by means of statistical parametric mapping (SPM8).

Results - Compared to age-matched control subjects, patients in MCS MINUS showed significant hypometabolism in the left dominant hemisphere encompassing the language network. Recovery to MCS PLUS was paralleled by recovery of metabolism in the right temporo-occipital areas, including hippocampus and parahippocampus.

Conclusion - Recovery of language understanding and command following in severe massive left-hemispheric brain-damaged patients with MCS MINUS seems to correlate with an increase in contralateral right hemispheric metabolic activity rather than in peri-lesional areas as can be observed in aphasia and focal stroke lesions (3). Given that right hemisphere activity has been associated with negative language recovery in aphasia, these data suggest a high probability of language impairment in MCS PLUS patients.

References

1. Bruno et al. (2011). *Journal of Neurology*, 258(7), 1373-1384.
2. Giacino et al. (2004). *Archives of physical medicine and rehabilitation*, 85(12), 2020-2029.
3. Heiss et al. (2003). *Neuroimage*, 20, S42-S49.

P021 - Discrepancy between subjective and objective interoceptive judgments predicts anxiety and emotion deficits in Autism

Sarah N. Garfinkel* [1,2], Claire Tilly [3], Stephanie O’Keeffe [3], Neil A. Harrison [1,2,4], Anil K Seth [3,5] and Hugo D. Critchley [1,2,4]

[1] Psychiatry, Brighton and Sussex Medical School, Falmer, BN1 9RR, UK, [2] Sackler Centre for Consciousness Science, University of Sussex, Falmer, BN1 9RR, UK, [3] Brighton and Sussex Medical School, Falmer, BN1 9RR, UK, [4] Sussex Partnership NHS Foundation Trust, Brighton, BN2 3EW, UK, [5] Department of Informatics, University of Sussex, Falmer, BN1 9QJ, UK.

Conscious experiences of emotions are influenced by signals from the body. The detection of internal bodily sensations, a process known as interoception, informs emotional feeling states. Autism Spectrum Conditions (ASC) are associated with differences in identifying and processing emotion. Reduced interoceptive accuracy in people with ASC may thus underlie aspects of altered affective processing. However, this hypothesized deficit in interoception contrasts with clinical observations that people with ASC generally express a heightened self-perception of body state. Based upon our theoretical framework, positing distinct psychological dimensions to interoception (Garfinkel & Critchley, 2013; Garfinkel, Seth, Barrett, Suzuki, & Critchley, 2014), we sought to reconcile these apparent discrepancies: In people with and without ASC, we measured their objective interoceptive ability (using heartbeat detection tests to quantify interoceptive accuracy) and their subjectively-reported sensitivity to internal bodily sensations (using a self-report questionnaire to quantify interoceptive sensibility). ASC was associated with both reduced interoceptive accuracy and heightened interoceptive sensibility,

reflecting both an impaired objective ability to detect bodily sensations and an over-inflation of subjective interoceptive perceptions. The divergence of these two measures of interoception can be conceived as a trait prediction error. This metric correlated with deficits in emotion sensitivity and was positively related to anxiety symptoms. Together these results indicate an origin of emotion deficits and affective symptomatology in ASC at the interface between body and mind, specifically in the expectancy-driven interpretation of interoceptive information.

References Garfinkel, S. N., & Critchley, H. D. (2013). Interoception, emotion and brain: new insights link internal physiology to social behaviour. *Social Cognitive and Affective Neuroscience*, 8(3), 231-234. Garfinkel, S. N., Seth, A. K., Barrett, A. B., Suzuki, K., & Critchley, H. D. (2014). Knowing your own heart: Distinguishing interoceptive accuracy from interoceptive awareness. *Biological Psychology*.

P022 - A musical rhythm-based Brain-Computer Interface to index auditory perception and attentional control in patients with Disorders of Consciousness

Raechelle M. Gibson [1], Adrian M. Owen [1], & Damian Cruse [1]

[1] Brain and Mind Institute, University of Western Ontario, London, CAN.

Brain-computer interfaces (BCI) refer to a category of devices that use electrophysiological signals to modulate the activity of a computer. Non-communicative individuals, e.g., those with Disorders of Consciousness (DOC), can benefit from BCIs because these devices can provide an assessment of covert cognition not available with traditional behavioural tests. In some cases, a BCI may even provide a means of overt communication for a patient. The current work describes a BCI that can detect markers of auditory perception and attention. Healthy participants (n=16) listened to auditory rhythms of varying complexity. More complex auditory rhythms were marked by more robust P300 responses than relatively simpler auditory rhythms (289-471 ms, group cluster $p = 0.002$). Interestingly, only the relatively simpler auditory rhythms generated differentiable cortical responses between attended rhythms and unattended rhythms (150-236 ms, group cluster $p = 0.048$). For this reason, future work with patients will only employ simple auditory rhythms for BCI control (e.g., attend to communicate 'yes' and ignore to communicate 'no'). Overall, these results are promising for future work with DOC patients in that this BCI will allow for the identification of a patient's ability to detect temporal complexity, while simultaneously providing a communication device for those patients with sufficient attentional resources.

Acknowledgements: This work was supported by the Canada Excellence Research Chairs program, the Vanier Canada Graduate Scholarships program, the Canadian Institutes of Health Research, and the Natural Sciences and Engineering Research Council of Canada.

P023 - Probing consciousness in DOC patients with auditory steady-state responses

Urszula Górska [1], Marek Binder, PhD [1], Marcello Massimini, PhD [2] [3]

[1] Psychophysiology Laboratory, Institute of Psychology, Jagiellonian University, Cracow, Poland, [2] Department of Biomedical, Clinical Sciences Luigi Sacco, University of Milan, Milan, Italy, [3] Istituto di Ricovero e Cura A Carattere Scientifico, Fondazione Don Carlo Gnocchi, Milan, Italy.

Objective: The principal objective of this study was to determine the level of awareness in DOC patients using ASSR (auditory steady-state responses) stimulation presented with a range of modulation frequencies. In the pilot study the sensitivity of this technique as a tool to discriminate the level of consciousness was confirmed in control group in deep sleep (N2 and N3 phases) and awake conditions. ASSRs are also sensitive to the depth of general anesthesia (Plourde, 2006). The possible advantage of using ASSR to estimate the level of consciousness in non-communicative patients is based on its relative ease of use and non-invasiveness.

Methods: Healthy controls and 12 DOC patients (4 MCS and 8 VS, diagnosis based on CRS-R results) were presented a series auditory stimuli (carrier frequency 1000Hz) modulated by the set of amplitude modulation (AM) frequencies (4Hz, 8Hz, 20Hz, 40Hz) while measuring their brain activity with 64-channels EEG. During analysis we estimated ASSR amplitude with F-test and ASSR phase variability with squared phase coherence (PC) index. Statistical analysis involved repeated measures two-way

ANOVA with within-subjects factor of modulation frequency and between-subject factor of subject state (control, MCS, VS).

Results: Analysis of ASSR amplitudes revealed no significant effect of subject state. This is probably caused by a very high variability of individual ASSR amplitudes...

P024 - Outcome Prediction in Early-Stage Coma: Avoiding Falsely Pessimistic Predictions

Alex López-Rolón [1], Andreas Straube [1], Andreas Bender [1]

[1] Department of Neurology, University of Munich, Munich, Germany.

The scientific study of consciousness finds one of its frontiers in the study of chronic disorders of consciousness (DOC) caused by acquired brain injury. As reductionist as it may sound the conceptual fog that plagues consciousness as a construct tends to clear, at least partially, when we observe how injury to specific areas of the brain correlate with the diagnostic categories in the current classification of DOC. It is also in the prosaic clinical setting of an intensive care unit (ICU) where the most important debates on human consciousness you never hear of occur on a daily basis. Is the patient alert? Is the patient aware? Will a particular comatose patient ever recover consciousness? Considering the current state of consciousness should we continue or discontinue life-sustaining therapy? These questions are a matter of life and death and the daily staple of the work of intensivists. Outcome prediction constitutes a particular challenge at the ICU. The decision to either continue or stop life-sustaining therapy is frequently made during the first weeks after admission. Not only is it based on prognosis parameters that have come into question in recent years, it may be affected by falsely pessimistic predictions that cause a negative self-fulfilling prophecy where life-sustaining therapy is withdrawn because prognosis is supposedly poor which leads in turn invariably to a poor outcome. Whether we choose to address the issue of outcome prediction at the ICU either solely in a mechanistic, purely technical fashion void of any theoretical underpinning, as it is often the case, or from a multidisciplinary, theoretically driven perspective, has significant implications for the progress of our understanding of disorders of consciousness on fronts that vary from the ethical to the neuroscientific. We present HOPE (i.e. Hypoxia and Outcome Prediction in Early-Stage Coma) the first multicenter prospective cohort study that aims to improve outcome prediction while controlling for a self-fulfilling prophecy in the decision making process in the ICU. In addition to this novel feature, unlike previous studies, HOPE follows patients after the ICU both during and after their treatment at neurorehabilitation clinics. HOPE will produce a data base that would not only allow us to make potentially groundbreaking empirical advances in critical care, but also examine decision-making in outcome prediction in DOC from a multidisciplinary perspective.

P025 - Residual sensorimotor function in Disorders of Consciousness

Natalie Osborne [1], Adrian Owen [1], Davinia Fernández-Espejo [1]

[1] The Brain and Mind Institute, Western University, London, Ontario

Functional magnetic resonance imaging (fMRI) is a key tool for detecting covert residual cognitive function in patients with disorders of consciousness (DOC). While active paradigms (e.g. mental imagery tasks) have shown great success in demonstrating covert awareness in these patients, they are very cognitively demanding and therefore only effective in a small subset of them. Passive tasks, however, do not require the patient's active participation, and therefore allow the study of preserved cognitive function in a higher number of patients. Although they do not allow for direct claims about preserved awareness, measuring brain responses to passive presentations of different stimuli can provide important information on residual functioning in the associated neural systems. Indeed, passive paradigms have successfully been used to study auditory (e.g. noise, words, stories), emotional (e.g. patient's name, baby cries), and visual (e.g. colours, shapes, moving objects) processing in DOC patients. However, to date, motor function in these patients has not been explored. Interestingly, most DOC patients are capable of spontaneous movement, while incapable of moving to command. The specific contributions of impairments in the motor system, or in cognitive processes associated with volition, to each patient's lack of behavioural command following is unknown in the absence of active

fMRI data. In the current study, we used fMRI to assess the neural response to passive movements of the arm in DOC patients, as compared to 15 healthy controls. We alternated between two different arm movements throughout the session to discourage subjects from anticipating the movement. Healthy controls showed robust activation in sensorimotor-related regions including M1, S1, and SMA. Interestingly, two DOC patients also showed significant activation in response to the task, although restricted to M1 (patient 1), or S1 (patient 2). Activation in these regions, induced by somatosensory signals associated with passive movement, could indicate functional preservation of a patient's sensorimotor pathway. Further testing will determine if neural responses to passive movements are associated with diagnosis or prognosis, as well as the potential use of this task for assessing neurological benefits associated with physical rehabilitation.

P026 - Grey and white matter markers of dissociation in first-episode psychosis

Charlotte L Rae* [1,2], Geoff Davies* [3,4], Sarah N Garfinkel [1,2], Kathryn Greenwood [3,4], Anil K Seth [1,5], Nick Medford [1,2,4], Hugo D Critchley [1,2,4]

***These authors contributed equally to this work.**

[1] Sackler Centre for Consciousness Science, University of Sussex, UK, [2] Department of Psychiatry, Brighton & Sussex Medical School, UK, [3] School of Psychology, University of Sussex, UK, [4] Sussex Partnership NHS Foundation Trust, [5] School of Engineering & Informatics, University of Sussex, UK.

Dissociation represents a dysfunctional state of consciousness, in which an individual's internal thoughts and sensations (depersonalisation), or experience of the world around them (derealisation), are perceived as oddly altered or unreal. Such depersonalisation and derealisation symptoms may be hallmarks of the early stages of psychosis. However, the neural mechanisms underlying dissociative experiences in first-episode psychosis, their prevalence, and how these influence long-term prognosis, are unknown. In a cross-sectional study combining multimodal neuroimaging and neuropsychological evaluation, 40 patients with first-episode recent onset psychosis and 20 age, gender, and education matched controls underwent T1 and diffusion MRI scans, and completed a number of behavioural tasks relevant to dissociation. These included a metacognitive perceptual introspective ability task (Fleming et al., 2010, Science) and a heartbeat detection task measuring interoceptive accuracy, awareness, and sensibility (Garfinkel et al., 2015, Biol Psych). Patients also completed the Cambridge Depersonalisation Scale (CDS) at time of first assessment, measuring dissociative symptoms within the last 6 months. Patients showed striking individual differences in dissociation, with CDS scores ranging from 4 (low dissociation) to 187 (high) with a group mean of 61. In whole-brain voxel-based morphometry and tract-based spatial statistics analyses of the T1 and diffusion MRI data, we tested for correlations of patient trait CDS scores with grey matter volume and white matter structure (fractional anisotropy and mean diffusivity). Furthermore, in both the patients and controls, we examined the relationship between such grey and white matter structural markers and (i) state CDS (measuring dissociative symptoms on the day of the scan), (ii) metacognitive perceptual introspective ability, and (iii) interoceptive accuracy, awareness, and sensibility. To elucidate the contribution of specific white matter structural features to dissociative experience, we performed a 'neurite orientation and dispersion density' (NODDI) analysis of the diffusion MRI data, partitioning the effect of axonal packing density from the effect of axonal orientation. The long-term prognosis of the patient participants will be followed up 12 months on from study participation, to determine whether such structural markers of dissociation are predictive of psychotic relapse or remission.

MEASURES OF CONSCIOUSNESS - I

P027 - Flexible Interaction as a Criterion for Consciousness

Robert Foley [1,2]

[1] Dept. of Philosophy University of Western Ontario, [2] Rotman Institute of Philosophy University of Western Ontario, [3] The Brain and Mind Institute University of Western Ontario.

The two standard methods of attributing consciousness of an object (henceforth consciousness) to a subject in psychophysical studies are reportability and above chance performance in forced-choice discrimination tasks. Behavioural criteria, such as the latter, have largely been rejected, in part, due to evidence that unconscious perceptual processing can have an effect on subjects' task performance. Instead, reportability criteria have become the 'gold standard' for the attribution of consciousness to a subject. Despite this reliance on reportability in psychophysics, it is questionable whether reportability is a reliable indicator of either consciousness or the lack thereof. Some philosophical accounts have attempted to address this issue by arguing for a close link between intentional access to information and consciousness. However, when such accounts are applied to the empirical literature, they tend to collapse into either standard behavioural or standard reportability criteria. In line with such 'intentional accounts', I propose a criterion for the attribution of consciousness to a subject that relies on a subject's capacity to use information flexibly (FI). FI states that: If a subject exhibits the capacity to use information about an object to guide their goal-oriented actions in an object appropriate and flexible fashion, they are conscious of that object. I outline what is meant by the flexible use of information in FI, and argue that the link between FI and consciousness holds at least as much intuitive force as reportability. Indeed, in certain contexts, it can trump reportability. In addition, I argue that FI is compatible with empirical evidence that undermines standard behavioural criteria. I then outline how FI can be operationalized and propose a means for testing its dissociability from both reportability and standard behavioural criteria. Finally, I suggest how this approach can contribute to recent empirical debates. I conclude that FI offers an empirically and philosophically adequate means of investigating consciousness that has not yet been pursued.

P028 - Objective and subjective measures of statistical learning of word-referent pairs

Ana Franco [1], Axel Cleeremans [1], Arnaud Destrebecqz [1]

[1] Center for Research in Cognition and Neurosciences, Université Libre de Bruxelles, Belgique.

In cross-situational learning, participants learn word meanings by processing statistical regularities of co-occurrence between auditory presented words and pictures of their referents. After being exposed to these regularities, learning is measured through a recognition task in which participants have to associate words and their referents. Results of Experiment 1 show that participants learned equally well two different sets of associations. In Experiment 2, participants were successively exposed to these two sets of associations. Cross-situational learning and the conscious accessibility of the acquired knowledge were measured by using an adaptation of the Process Dissociation Procedure (Jacoby, 1991) to the recognition task, combined with binary confidence judgements. Results show that participants successfully learned the two sets of associations. They were also able to control their use of this knowledge as they accurately identified the set to which each association belonged. Confidence judgments revealed that participants correctly identified the learned associations even when they claimed to guess. These results suggest that cross-situational learning involve a mixture of both conscious and unconscious influences.

P029 - The effect of online awareness measures on the artificial grammar learning

Ivan I. Ivanchei [1], Nadezda V. Moroshkina [1]

[1] St. Petersburg State University, St. Petersburg, Russia.

Implicit learning is a process of unintentional learning of complex regularities in the environment. The representations acquired during such kind of learning are hardly verbalizable and presumably unconscious. The conscious status of such representations has been a hot topic over the last few decades. Thus implicit learning research requires well-developed awareness measurement techniques. Trial-by-trial (online) measures solve a number of problems associated with after-experiment awareness assessment. However they can cause new issues, as long as they can be seen as additional variables influencing behavior under investigation. We explored how people perform implicit learning task under different online awareness measures. The artificial grammar learning paradigm was used. In the learning phase all the participants memorized letter strings constructed according to the complex set of rules (artificial grammar). In the test phase they were asked to classify new strings as consistent or inconsistent with these rules. All the participants were divided into four groups in the test phase. Three groups of participants performed the classification task with different awareness measures: confidence ratings, post-decision wagering, and decision strategy attribution. Control group performed the task without any awareness measure. Decision strategy attribution subjects demonstrated higher classification accuracy and reaction times, and more conservative bias in comparison with controls. The impact of stimuli grammaticality on classification decisions was also larger in decision strategy attribution group, indicating reliance on the rule-based knowledge instead of pure statistical learning. Confidence ratings and post-decision wagering increased only reaction times. The presence of the online awareness measures did not affect subjects' performance in strings generation task, completed after the experiment. We made a conclusion that decision strategy attribution task forced subjects to adopt analytical processing style and rely mostly on available conscious knowledge of the artificial grammar. The results are important for the improvement of existent awareness measures and the development of new methods. Some theoretical implications consistent with dual-process approach to implicit learning can also be derived from the present study. This study has been supported by St Petersburg State University (project number 8.38.287.2014).

P030 - How to measure unconscious processing ?

Dominique Lamy [1], Ziv Peremen [1]

[1] Tel Aviv University, Israel.

Delineating the limits of unconscious processing in order to understand the function of consciousness in vision has been a central goal for research in the last decades. However, what methodology is best suited to uncover unconscious processing - and absence thereof - remains controversial. The gold standard for demonstrating unconscious processing has been to show evidence for perceptual processing of a subliminal stimulus using an indirect measure and then to confirm that this stimulus was indeed subliminal by showing that it cannot be discriminated better than at chance level, in a separate block of trials. Here, we critically reevaluate this standard based on a review of recent research from our lab, with special emphasis on the roles of the measures used to gauge conscious perception, the paradigms used to prevent conscious perception and (3) top-down factors, namely attention and template availability. Relying on these findings, we suggest methodological guidelines for future research on unconscious processing that allow (1) determining which processes are contingent on conscious perception and which are independent of it, (2) maximizing the chances of detecting unconscious processing and (3) comparing the different methods used to suppress conscious vision.

P031 - Content, scale format, and type 2 sensitivity of subjective measures of consciousness

Manuel Rausch [1], Michael Zehetleitner [1]

[1] Department of Psychology, Ludwig-Maximilians-Universität München, Munich, Germany.

Using subjective measures of consciousness raises multiple methodological issues, including what contents should participants be asked to report, how these reports can be recorded, and what statistical procedures should be used. Concerning content, reports about the confidence in the accuracy of task responses are associated with lower psychophysical thresholds, greater type-2 sensitivities, and earlier EEG correlates than reports of visual experience. Concerning recording technique, more precise reports of visual experience can be recorded by visual analog scales than by discrete labeled scales. Concerning statistics, logistic regression is a poor method to quantify the magnitude of type-2 sensitivity compared to meta-d' but may be a powerful method to test if there is a correlation between reports and task accuracy at all. Overall, we suggest the study of consciousness increasingly benefits from subjective reports if methodological choices are tailored to the research questions.

P032 - How robust are subjective measures and what do they measure? Impact of task order, stimulus- and response set.

Bert Timmermans [1]

[1] University of Aberdeen.

Despite advances in behavioural and neurobiological measures of consciousness, one cannot escape the fact that the ultimate authority about whether one is conscious of something has to be the person's phenomenology. Thus, subjective methods of asking people for the clarity of an experience or confidence in their judgment, remain essential. However, interpreting such measures is subject to a number of pitfalls: what do they measure and how best to measure that? We present a number of studies looking at (a) how dependent subjective measures are on when they are administered, and (b) investigate whether they pertain to the stimulus awareness or to judgment knowledge. (a) When establishing objective and subjective thresholds for awareness, it is customary to first ask people to make a decision, and only subsequently to ask them about their subjective experience. In a set of forced choice decision task studies we look at whether the mere identification of a stimulus has an influence on the subsequently measured subjective awareness of said stimulus; and whether assessing awareness, and metacognitive accuracy, has an influence on subsequent identification accuracy. Results show that correlation between awareness and performance is higher when awareness is assessed first. (b) In a second set of studies, we look at whether awareness judgments are influenced by stimulus or response set and whether this associates them with or dissociates them from decision accuracy, by changing diagnosticity of stimulus features, and by changing relative difficulty of the stimulus. Results show that tests asking for perceptual awareness are not sensitive to changes to stimulus or response set, whereas confidence ratings are. This suggests that confidence ratings are not assessing perceptual awareness, but metacognition or judgment knowledge. The discussion focuses on implications for use of subjective measures in future research, depending on the paradigm and what one aims to measure.

P033 - How do we know what we see ? The influence of visual identification decision on visual awareness ratings

Michał Wierchoń [1], Marta Siedlecka [1], Borysław Paulewicz [2]

[1] Consciousness Lab, Jagiellonian University, Institute of Psychology, Krakow, [2] University of Social Sciences and Humanities, Faculty in Katowice.

How do we know what we see? Is this only the effect of perceptual evidence accumulation; or do we use some other information to judge our metacognitive awareness? Here, we present four studies aiming to test the relations between visual identification and visual awareness by investigating the effects of decision in identification task on subsequent subjective awareness ratings. In all experiments, we have applied perceptual awareness scale in the context of a visual identification task with Gabor patches either before, or after the identification task decisions. Results of first two studies clearly showed that awareness ratings strongly predicted accuracy, but the overall relationship between awareness ratings and performance was weaker, when participants rated their awareness before providing identification responses. We concluded that the identification task affected subsequent awareness ratings and proposed that this could be a result of either longer time that participants required to estimate their certainty in the identification decision, or the influence of the decision itself on awareness rating. Thus, we run two additional studies that aimed to test those two contradictory interpretations by separating decision time and identification/awareness rating order influences. In the third study we manipulated the amount of time participants had to rate their awareness, while the identification decision was always made after visual awareness ratings. In the fourth study we used the task order manipulation, but controlled the time participants had to rate their awareness in both conditions. The results showed both, the effect of time participants had to rate their awareness, and also the effect of decision on awareness ratings. We interpret those results in line with hierarchical theories of consciousness suggesting that metacognitive awareness is based on low-level visual processing, but also influenced by post-decision processing.

MIND-BODY PROBLEM

P034 - Embodiment and Bionic Vision Restoration

Tommy Cleary [1,2]

[1] School of Philosophy and Theology, University of Notre Dame Australia, [2] Australian Health Services Research Institute, University of Wollongong, NSW, Australia.

This poster will explore and describe some philosophical implications of Bionic Vision Restoration research. The prosthetic restoration of sight can begin to test current philosophical distinctions of mind, body and world. The challenge of finding an adequate approach is encountered when the conceptual and neurobiological horizons of vision restoration are contemplated; where it can be difficult to avoid thinking that implies that consciousness is nowhere or potentially everywhere. Well aware of the difficulty of finding an adequate approach, this poster seeks to help craft a path toward healing. It will aim for this goal by beginning with a contemplation of the embodiment of perception in the context of the prospect of vision restoration. Here in the flesh of perception, phenomenology is demonstrably inescapable. Also, despite the inherent ambiguity of perception, phenomenology is important in avoiding half-truths as we re-explore the internal and external surfaces of being human.

P035 - Shifting the Hard Problem via an Experience-Based Processual Approach

Linda Dayem [1]

[1] University of California, Santa Cruz.

The study of consciousness as a phenomenon that is localizable within physical entities like the brain is the current dominant approach in the scientific study of consciousness. This approach leads to research on the functional characteristics of the physical systems involved in conscious experience, or what David Chalmers terms the “easy problems” of consciousness. If, however, consciousness is something more than reductionistic explanations of brain mechanisms, how can the “hard problem” be addressed without resorting to either dualism or explanations that grant consciousness to inanimate objects? Based on the work of William James and Alfred North Whitehead, I discuss an experience-based processual approach that takes “moments of experience” as primary and ubiquitous. Moments of experience, in this sense, are more than vaguely defined, subjectively constrained, qualitative phenomena, but are causally efficacious, actual entities in their own right – not substantial, but functional entities. Differentiated by complexity, they can have high-level functions like human consciousness, but also extremely low-level functions such as an electron’s rote continuation of the current status quo. Differentiated temporally, a present moment of experience can be thought of as an algorithm (1) whose input are past actualities (completed moments of experience), (2) whose functions are, based on its intentionality, to interpret this past and to select between various possibilities for the future, and (3) whose output actualizes the present moment. In this way, the present moment is a causal process of actualizing ongoing reality based on limitations imposed by the structure of the past. The implication for the scientific study of (human) consciousness is that what we think of as the physical brain, effectually constitutes an objective material trace in the past, which sets up a structure of possibilities for future conscious actions, while the fundamental aspect of the present is subjective experience qua this functional algorithm. Instead of viewing human consciousness as resulting from physical processes in the brain, empirical studies can then be approached from this novel perspective of the temporal relation between active, conscious processing in the present moment, and completed moments of (brain) experience in the past.

P036 - A Metaphysical Study on the Predictability of Mind

Abraham Lim Ken Zhi [1]

[1] Graduate student in The Institute of Philosophy of Mind and Cognition, National Yang-Ming University.

The aim of my paper is to undermine or even refute the notion of predictability, especially the predictability of mind in metaphysical manner, by examining three scenarios presupposing predictability. The first scenario is developed by Stefan Rummens and Stefaan E. Cuypers whose aim was to show that the general notion of predictability is self-defeating by indicating that there is a paradox in this scenario. I will point out that some restrictions must be made for the paradox to hold. Especially, their argument may not be applied to mental event. By analyzing the second scenario, I will introduce my own argument to show that, if actualized, the predictability of mind would contradict two common senses about knowledge. To establish my argument, I will have to analyse the difference between knowing something and discovering something, borrowing the analysis of knowledge put forth by Linda Zagzebski. The third and the last scenario will show that, if actualized, predictability of mind would yield some oddity. I will also discuss how the predictability of mind would meet the problem of individuating thoughts.

MODELS & THEORIES OF CONSCIOUSNESS - I

P038 - Typological approach to analysis of various consciousness research programs

Garnik Akopov [1]

[1] Samara State Academy of Social Sciences and Humanities, [2] Department of Psychology, [3] Head of General and Social Psychology Department, [4] Doctor of Psychological Sciences, [5] Professor.

Systematization of consciousness research is an important metacognitive task. One of the first systematizations was performed by D. Chalmers (1995). It consisted of 3 classes of 17, 20 and 16 thematic groups, 1,324 scientific texts about consciousness. Significantly increased in quantity and variety of contents material was presented by C. Whitehead during extensive review of conferences on the problem of consciousness in Tucson during 1994-2004. We track relevant material under three interrelated criteria of typologization of consciousness research: 1. Purpose and relevant content of research (consciousness, physical, biological, social, informational and other worlds); 2. Logical organization or organizing research method (unitary, interdisciplinary, comprehensive, systemic, synergetic etc.); 3. The personal dominant of the researcher (natural sciences - physicalism, humanitarian, paradigmatic, syntagmatic, consolidated, integrated etc.). In a more abstract notation, following the concept of V. Petrenko on multidimensionality of consciousness, one can imagine the space of consciousness studies, respectively, in the following dimensions: the substantial -Ideal (immaterial definition of consciousness); spontaneous (free) - determinational functioning of consciousness; utilitarian (pragmatic) - valuable attitude to consciousness.

P039 - Chasing a mirage – the quest for the genuine neural correlate of consciousness

Leon Y. Deouell [1]

[1] Department of psychology and the Edmond and Lily Safra Center for brain sciences, The Hebrew University of Jerusalem, Israel.

Looking for the neural correlates of consciousness (NCC) has been suggested as a strategy for addressing the neurobiological foundation of consciousness, while avoiding the 'hard problem' or the 'explanatory gap' between the objective and the subjective. Indeed, this paradigm yielded a critical volume of data. However, there is a recent trend in the literature highlighting the fact that the empirical search for the NCC frequently confounds the 'NCC proper', or 'genuine NCC', with processes which are mere prerequisites or consequences of being consciously aware. Furthermore, it was argued that with careful attention to methodological details, it will be possible to use cognitive neuroscience to distill the NCC proper, arguably the real goal of the field, denuded of the prerequisites and of the consequences of conscious awareness. This view is echoing widely, becoming sometimes a benchmark for new research. I will challenge this claim, and argue that any result that seems like NCC proper, once carefully examined, will turn out to be (or could be regarded as) either a prerequisite for conscious awareness or a consequence thereof. Further, I will suggest that if anything such as an NCC proper exists, it can only be recognized on a priori, theoretical grounds, rather than on empirical arguments. Finally, I will argue that this is not a pessimistic view, as charting the full picture of the prerequisites and consequences of conscious awareness, with their complexity, is a rewarding goal for the cognitive neuroscience of conscious awareness.

P040 - Manipulating word awareness dissociates feed-forward from feedback models of language-perception interactions

Jolien C. Francken [1], Erik L. Meijs [1], Odile M. Ridderinkhof [2], Peter Hagoort [1,3], Floris P. de Lange [1], Simon van Gaal [1,2]

[1] Radboud University, Donders Institute for Brain, Cognition and Behavior, Nijmegen, Netherlands, [2] Department of Psychology, University of Amsterdam, Netherlands, [3] Max Planck Institute for Psycholinguistics, Nijmegen, Netherlands.

Previous studies suggest that linguistic material can modulate visual perception, but it is unclear at which level of processing these interactions occur. Here we aim to dissociate between two competing models of language-perception interactions: a feed-forward and a feedback model. We capitalized on the fact that the models make different predictions on the role of feedback. We presented unmasked (aware) or masked (unaware) words implying motion (e.g., rise, fall), directly preceding an upward or downward visual motion stimulus. Crucially, masking leaves intact feed-forward information processing from low- to high-level regions, whereas it abolishes subsequent feedback. Under this condition, participants remained faster and more accurate when the direction implied by the motion word was congruent with the direction of the visual motion stimulus. This suggests that language-perception interactions are driven by the feed-forward convergence of linguistic and perceptual information at higher-level conceptual and decision stages.

P041 - Quasi-Conscious Multivariate Systems

Jonathan William Mason [1]

[1] Mathematical Institute, University of Oxford, Oxford, UK.

Conscious experience is awash with relationships: points in our field of view can be related or unrelated, giving geometry; colours can appear similar or different; the brightness of grey appears between that of black and white; for several brain regions, a person's name is related to their appearance etc. For various brain regions such as V1, the system is biased toward some states. Representing this bias using a probability distribution shows that the system can define expected quantities. This talk presents a mathematical theory that links these facts. Under the requirement of minimising expected float entropy (EFE), the brain defines relationships. It is proposed that when a brain state is interpreted in the context of these relationships the brain state acquires meaning in the form of the relational content of the associated experience. I'll define EFE and give examples, obtained using Monte Carlo methods, which suggest that EFE distributions with long left tails are important.

P042 - Neuro-dynamical accounts for postdiction

Shingo Murata [1], Yuichi Yamashita [2, 3], Hiroaki Arie [4], Tetsuya Ogata [4], Jun Tani [5], and Shigeki Sugano [1]

[1] Department of Modern Mechanical Engineering, Waseda University, Tokyo, Japan, [2] Department of Functional Brain Research, National Center of Neurology and Psychiatry, Tokyo, Japan, [3] Cognition and Behavior Joint Research Laboratory, RIKEN Brain Science Institute, Saitama, Japan, [4] Department of Intermedia Art and Science, Waseda University, Tokyo, Japan, [5] Department of Electrical Engineering, Korea Advanced Institute of Science and Technology, Daejeon, Republic of Korea.

Postdiction, a perceptual experience in which an event occurred later causally affects the perception of another event occurred earlier, is considered as one of the characteristic features of human subjective experience. In the current study, we hypothesize that postdiction phenomenon arises as a by-product of the essential neural mechanisms for adaptive behavior. The proposed idea was implemented using a hierarchical neural network model whose objective function has the same form as that used in the free-energy formulation of active inference. The hypothesis was tested through a series of neuro-robotics experiments in which a humanoid robot driven by the neural network model was required to generate adaptive behavior via interactions with its physical environment. The experiments demonstrated that two different types of behaviors emerged depending on different ways of treating

uncertainty. One is sensory reflex behavior with high uncertainty in which the robot adapts to unpredictable change in environment by simply responding to sensory inputs, and the other is intentional proactive behavior with low uncertainty. In the latter case, the robot re-situated the behavioral context by utilizing error regression scheme in which the internal neural activity was modified in the direction of suppressing prediction errors. Notably, re-situation of the behavioral context through the prediction error minimization is made possible by iterative processes of sensory-motor prediction over again so that the re-generated prediction is consistent with actual sensory feedback. In this iterative re-generation process, time window including appropriate length of the past time played a crucial role. Specifically, in the experiments, during this re-generation of prediction, we observed postdiction like phenomenon, in the sense that actual sensory feedback based on what the robot did earlier was overwritten by the re-predicted (postdicted) sensory-motor sequences consistent with subsequently occurred unpredictable events in environment. This observation provides a mechanistic explanation that postdiction phenomenon may arise as a result of essential neural computation of minimizing prediction error for adaptive behavior. Moreover, the proposed model may contribute to the investigation of neural mechanisms of postdiction by proposing a testable prediction, for example, postdiction phenomenon is likely to occur in proactive conditions rather than in sensory reflexive conditions.

P043 - Sensory Modalities and Quality-Space Theory

David Rosenthal [1]

[1] Philosophy and Cognitive Science, Graduate Center, City University of New York.

Prior proposals for individuating the sensory modalities rest on incompatible criteria, from phenomenology to proximal stimuli, representational character, or sense organs. I present a method that uses a novel technique for taxonomizing the mental qualities themselves, and so requires no independent assumptions. Quality-space theory types mental qualities by relative location in a quality space based on discriminative ability. Just-noticeable differences (JNDs) define a space of discriminable stimuli; since the mental qualities that figure in perception enable those discriminations, a space that maps discriminable stimuli also maps the corresponding mental qualities. I extend this method to individuate the modalities. If no chain of JNDs connects two stimuli, the corresponding mental qualities belong to distinct modalities. JND chains occasionally lead from a few stimuli to distinct large groups not otherwise connected. But this is so rare that the test for distinct modalities survive.

P044 – How NCCpr and NCCae may be NCC-in-disguise: a reminder from the microgenetic stance

Talis Bachmann [1]

[1] Laboratory of Cognitive Neuroscience (bachmannlab.com), Institute of Public Law, University of Tartu, Estonia, [2] Institute of Psychology, University of Tartu, Estonia.

The quest for neural correlates of consciousness (NCC) has been recently caught by a hiccup. It appears that when we use contrastive analysis of brain-process data gathered in conscious vs unconscious conditions with invariant stimuli not only NCC directly corresponding to conscious experience are extracted, but also prerequisite and aftereffect processes necessarily accompanying the NCC-processes are indicated (NCCpr and NCCae, respectively) (Aru, Bachmann, Singer, & Melloni, 2012; de Graaf, Hsieh, & Sack, 2012). How to overcome this methodological problem is not so obvious. Several complexities hindering further progress can be listed. First, the NCCpr need not and probably typically do not terminate when NCC proper becomes established. NCCpr becomes a part of NCC – a hidden part – and it is highly complicated to disentangle temporally simultaneous NCC aspects that are added from the aspects that constitute the former NCCpr now present together with the NCC proper. Second, the same applies to NCC vs NCCae. Third, when reporting about conscious experience subjects base their evaluations on the contents of consciousness. However, they do not report and realistically can not report all the contents present in their phenomenal experience. They (i) select a subpart on which to found their reports and leave the rest for good, (ii) they use certain criterion contents as the basis of their report and (iii) they use more or less conservative decision criteria when reporting

the contents. These circumstances leave open the possibility that actually the NCCpr and NCCae are still related to conscious experience, but subsumed under unconscious conditions because subjects are incapable or unwilling to report the qualitatively different contents from these pre- and after-stages. In the present talk a microgenetic perspective is used to explain how this problem could be experimentally treated. The key concepts here include NCC-general vs NCC-specific, NCC-as-expectancy vs NCC-as-actual, NCC-as-proto-image vs NCC-as-complete-image, and NCC-as-perception vs NCC-as-memory.

P045 - Subjective Character

Tobias Schlicht [1]

[1] Institute for Philosophy II Ruhr-Universität Bochum.

Subjective Character - Kenneth Williford (2015, OPEN-MIND.net) has put forward a new philosophical account of the subjective character of phenomenal consciousness. He maintains that such a theory has to respect (1) the relational structure of consciousness, and (2) the Humean intuition that one of the relata, the subject, remains somewhat invisible and is at least not constituted by a special (additional) entity. His solution is to peacefully combine these two intuitions by identifying the subject with (an episode of or) the stream of consciousness which is itself reflexively self-aware. This identity claim leads to the situation that the subject-pole of the consciousness-relation appearing (or being manifest) in the conscious episode is the episode itself. The subject-pole is thereby manifest, i.e. consciously experienced, but not separable as an entity from the conscious episode in question, and thus – in a sense – invisible. This paper points out problems of his identification of the subject with the stream (or episodes) of consciousness. In a second and third section, an alternative way of conceptualizing the subject will be presented. On this alternative view, a mental representation is conscious (i.e. exhibits subjective character) if it is integrated in the right way into the overall conscious state of the organism. By way of integration, all conscious representations are something for the organism, which is itself identified as the subject of experience. Williford faces a dilemma with respect to the individuation of episodes: If a single sensation of red is too simple to count as an episode, then Williford's theory can only explain why the complex episode as an emergent whole (having single experiences as its parts or elements) is conscious. It cannot explain what makes an individual element of this whole episode (or stream), a sensation of red say, conscious. But if a single sensation of red may count as an episode, then this gives rise to a multiplicity of (streams and consequently) conscious subjects. The basic idea of a positive alternative to this is that some of the multiple competing representations, like a sensation of red say, are phenomenally conscious because of being integrated into the one global conscious state of the organism that also contains the structures responsible for creature-consciousness (Van Gulick 2004). An argument is presented to the effect that we should identify the subject of experience with the organism itself.

P046 - Neuroscience of Consciousness: A new journal

Anil K. Seth [1], Biyu J. He [2], Jakob Hohwy [3]

[1] Sackler Centre for Consciousness Science, School of Engineering and Informatics, University of Sussex, Brighton, BN1 9QJ, United Kingdom, [2] National Institutes of Health, National Institutes of Neurological Disorders and Stroke, National Institutes of Health, Bethesda, MD 20892, USA, [3] Cognition & Philosophy Lab, Monash University, Clayton, VIC3800, Australia.

"It is remarkable that most of the work in both cognitive science and the neurosciences makes no reference to consciousness (or 'awareness')." So wrote Francis Crick and Christof Koch, a quarter of a century ago. Times have changed and consciousness science has since flourished. The launch this year of Neuroscience of Consciousness, an open-access journal published by Oxford University Press (OUP), reflects this progress and is a timely addition to the publishing landscape. The overall goal of the journal is to support the dissemination of research findings that illuminate the biological basis of consciousness in health and in disease, in humans and in other species. While the journal will maintain an emphasis on empirical neuroscience studies, its multidisciplinary foundation encourages submission of behavioural, methodological, theoretical (including modelling), and philosophical papers that exhibit a clear relevance to the biological basis of consciousness. We also emphasize a clinical dimension: the already intolerable and ever increasing burden of neurological and psychiatric illnesses, on individuals

and on society, underlines the need for new interventions based on a detailed understanding of how disrupted neural mechanisms engender disordered conscious experiences. A great variety of more specific topics fall within this general remit, which are (non-exhaustively) listed on the journal homepage <http://nc.oxfordjournals.org/>. We are delighted that the journal has an official partnership with the ASSC. There is a shared commitment on rigorous empirically testable approaches, informed by (and informing) work of a more theoretical and philosophical nature. Importantly, the historical balance within the ASSC between neuroscience, psychology, and philosophy, is fully embedded in the multidisciplinary scope of Neuroscience of Consciousness. This heralds, we hope, a long and productive engagement with the ASSC. Members of the editorial board will be present during ASSC19 (and at the poster session!) to encourage you to submit your excellent research to the journal, and to answer any questions. Notably, OUP has kindly waived all publication fees for 2015 so this is the perfect time to publish with us.

P047 - Is Consciousness Necessary for Human-Level Artificial Intelligence ?

Murray Shanahan [1]

[1] Imperial College London.

Human-level artificial intelligence, if it is developed at all, is almost certainly decades away. However, it is a prospect that has recently attracted a good deal of public interest and media attention. In the public debate, human-level artificial intelligence is often assumed to go hand-in-hand with consciousness: only a machine with consciousness could exhibit human-level general intelligence. But is this pre-theoretical intuition correct, or can the concepts of intelligence and consciousness be dissociated? In this paper, I will argue that to answer this question requires the concept of consciousness to be dissected. The crux of the issue is that human-level artificial intelligence is not necessarily human-like. We associate consciousness with a collection of psychological attributes that come bundled together in humans, but in an artificial intelligence could appear separately or not at all. On examination, some of these attributes, such as perceptual awareness and cognitive integration, seem to be more intimately connected with intelligence than certain others, such as the capacity for suffering or empathy. Given that a variety of forms of artificial intelligence is possible in this respect, the question arises of which, if any, it would be morally acceptable to develop.

P048 - On ‘Similar Enough’ Embodiment and Its Challenge to Our Theories of Consciousness

Robin L. Zebrowski [1]

[1] Departments of Philosophy, Psychology, and Computer Science at Beloit College (USA).

While there are still holdouts clinging to the strictly computational representational theories of mind, most researchers now agree that embodiment matters, in important ways, for understanding the nature of minds and our conscious experiences. Unfortunately, there has been a lack of critical examination of the very notion of “body” that we all rely so heavily upon now. When we do phenomenology, we generalize from our body to other bodies, and we assume that we aren’t doing phenomenology in a vacuum, applicable only to the person doing that work. We take phenomenology to be useful in part because it can say something generalizable. So how do we make sense of our allegedly shared phenomenology when there isn’t a single kind of body? Furthermore, how do we make sense of any of our theories of embodiment, from conceptual metaphor to embodied cognition, given the same premise? To make progress on this question, we can look to evidence from multiple sources that show us any claims to a shared human embodiment are highly problematic. The neuroscience of tool use has shown us that our body schema changes to incorporate tools as though they are temporary body parts, and there have long been arguments that some tools used often enough become akin to new sensory organs. (Merleau-Ponty, for example, makes a claim like this when speaking of feathered hats and the blind man’s cane.) Evolutionary biology constantly reminds us that the very notion of evolution is built on constant change over time. There is no single ideal human body (or genome), nor ought there to be. Variation is vital to the continuation of our species. Further, we can look to all sorts of social philosophy about gender, and race, and numerous social intersections of those facets of our bodies. Disabilities

studies literature offers decades of further argument and evidence against the notion of a shared kind of human embodiment or experience. And yet, the embodied cognition literature is undeniably powerful as an alternative to computational/representational theories. I will argue that theories of embodiment are overwhelmingly the appropriate research program for us to pursue in trying to solve the details of the mind-body problem. But I will also argue that it requires something like “similar enough” embodiment, and, at least right now, we have no idea what that means or how to even approach the problem.

PERCEPTUAL CONSCIOUSNESS - I

P049 - The extent of feature-selective suppression for masking motion

Egor Ananyev [1,2], Po-Jang (Brown) Hsieh [2]

[1] Department of Psychology, National University of Singapore, Singapore, [2] Duke-NUS Graduate Medical School, Singapore.

Binocular rivalry occurs when conflicting visual information is presented to two eyes, whereby the percept in one eye is said to “rival” the percept in the other eye. In continuous suppression paradigm, one of the percepts (mask) is intentionally made more salient than the stimulus of interest presented to the other eye. However, the classical continuous flash suppression (CFS mask) was found to be less effective in suppressing continuous motion (Moors, Wagemans, de-Wit, 2014). The objective of the present study was to investigate to which extent the effectiveness of novel dynamic masks in suppressing two- and three-dimensional motion depended on the outcome measure, type of motion, similarity in non-dynamic feature, as well as stimulus and mask speeds. A previous study found that the mask speed matching the stimulus speed led to highest rate of suppression (Moors, Wagemans, de-Wit, 2014). However, the results of the current study show that this is contingent upon the paradigm used. The implications of these findings for models of suppression (how stimuli rival for consciousness) are discussed.

P050 - Disentangling the visual NCC: Reducing low level features abolishes early ERP components and exposes P3b as the earliest ERP NCC

Gonzalo Boncompagni [1], Diego Cosmelli [1]

[1] Escuela de Psicología, Centro Interdisciplinario de Neurociencias, Pontificia Universidad Católica de Chile, Santiago, Chile.

A central aim in the empirical study of consciousness is to elucidate what neural activity is strictly related to the phenomena of conscious perception (CP), namely Neural Correlates of Consciousness (NCC). Different influential theories of consciousness like Global Neuronal Workspace and Integrated information Theory emphasize the importance of neuronal integration as a central aspect of perceptual consciousness. In this line a wide spread brain activation of associative cortices, like the P300 ERP component, is a consistent candidate for the earliest ERP NCC. Nevertheless studies assessing NCCs with EEG systematically show diverse and conflictive results. Many studies, even from groups supporting these theories, report differences in the magnitude of early ERPs like P1 to be correlated to conscious perception. Early ERP components like C1 or P1 are related to the processing of visual features of what is presented to subjects, like color, shape and texture, but they do not classically account for the integration of those features, as a NCC should. So we hypothesized that if we diminished the amount of feature processing required for our target, but we maintain the fact that subjects consciously perceive it, early ERP components should not correlate with conscious perception. To test this we designed an experimental paradigm using the classical contrastive analysis strategy but reducing as much as possible the amount of features of both the target alone and also the amount of features that distinguished the target from distractors. Our results show no early ERP component evoked, irrespectively if subjects detected it or not, which is consistent with the role of feature processing but not integration of these early components. Secondly we observed a robust P3b that was evoked only when subjects consciously perceived the target. This occurred for every single subject. In contrast to previous studies we don't only see a magnitude modulation of P3b component by conscious perception, but an all-or-nothing behavior, i.e. the presentation of the target without CP did not evoke a

P3b at all. It is important to remark that regardless of the minimal feature content of our target, the P3b evoked by the conscious perception of it had a magnitude equal or greater than what is usually reported using complex stimulus. Our results support the idea of P3b as the earliest ERP NCC, which is in line with these two integrative theories about consciousness.

P051 - Predictive information alters the visual awareness threshold by influencing response conservativeness, not processing efficiency

Esther De Loof [1], Filip Van Opstal [2], Tom Verguts [1]

[1] Department of Experimental Psychology, Ghent University, Belgium, [2] Center for Research in Cognition & Neurosciences, Université Libre de Bruxelles, Belgium.

Various theories have been proposed on why predicted information reaches consciousness faster. Biased competition theory claims that predictive information in higher-order processing areas biases neural activity in lower-order areas (Desimone & Duncan, 1995). Thus the visual processing of predicted information is selectively enhanced and it reaches the threshold of visual awareness faster. Interestingly, this process can be mapped onto the diffusion model (Ratcliff, 1978). The diffusion model contains a drift rate parameter that expresses processing efficiency and maps directly onto the biased competition mechanism. In addition, the model's threshold parameter expresses the amount of activation needed to respond to a stimulus. This mapping allows testing whether predicted stimuli could reach visual awareness faster than unpredicted stimuli due to more efficient processing (higher drift rate) or because of a lower response criterion (lower response threshold). For this purpose, we applied the DMAT toolbox (Vandekerckhove & Tuerlinckx, 2007) to estimate the drift rate and response threshold for predicted and unpredicted information in a masked priming paradigm. On each trial, a centrally presented cue (house, face or question mark) appeared before a target house or face picture, which was above or below fixation (48 ms). If the target was above (below) fixation, then a scrambled version of the picture was presented below (above) fixation; both were subsequently masked (48 ms). Participants indicated whether the full picture appeared above or below fixation. The cue predicted the target picture correctly in 80% of the trials (valid condition) but not in the other 20% (invalid condition); the question mark was not predictive (neutral condition). In line with previous findings, targets following a valid or neutral cue reached awareness faster than invalidly cued targets ($F(2,8191.8) = 21.636, p < 0.001$). In the diffusion model analysis, the drift rates were not significantly different across conditions ($F(2,57) = 0.51, p = 0.60$). However, the response threshold was significantly higher following an invalid cue compared to both valid and neutral cues (resp. $t(19) = 2.82, p = 0.011$ and $t(19) = 2.35, p = 0.029$). In sum our results indicate that predictive information influences how fast contents reach consciousness by shifting the response threshold rather than by enhancing processing efficiency.

P052 - Taxonomising Seemings

Jonathan Farrell [1]

[1] The University of Manchester.

In this paper, I offer a taxonomy of seemings: the mental states we are in when things seem some way to us. Philosophers appeal to seemings in different areas of philosophy. Reiland (2014) appeals to seemings to answer questions about the content of perceptual experiences. Bealer (1998) appeals to seemings to explain what intuitions are: intellectual seemings. And the papers in Tucker (2013) consider whether seemings can give us (defeasible) justification for some of our beliefs. But it is not obvious whether the seemings appealed to in each of these cases are the same kinds of states as those appealed to in the others. There are good reasons for being sceptical: it is widely recognised that we can mean different things when we use 'seem'. Chisholm (1957) describes two kinds. Epistemic seemings concern how we take the world to be (whether on the basis of perception or not). Thus if I read that City have lost their best player to injury, it might now seem to me that United will win this year's competition. And perceptual seemings concern our perceptions: the stick half in the water seems bent (even though I know it is not). There are also intellectual seemings: it seems to me that there could be a set that has as members all and only those sets that do not contain themselves (even though I know

that there could not be such a set). Experiential seemings are perhaps a genus of seeming, under which some other kinds of seemings (e.g., perceptual and intellectual) fall. We use the experiential sense of 'seem' to describe our experiences, and O's seeming F to us is compatible with our knowing that O is not F. Finally, justificatory seemings are mental states that give us (defeasible) reasons for accepting that the world is as it seems—e.g., if it seems that there is a dagger before me that is a (defeasible) reason for my believing that there is a dagger before me. It is because there are these (apparently) different kinds of seemings that it is an open possibility that the seemings discussed in, say, the philosophy of perception are not the same as those discussed in epistemology. My taxonomy will make clear what connections there are between the different kinds of seemings in play, and will help with the question of how we should characterise these different seemings: whether in terms of phenomenal character, or content, or whether the seeming is a propositional attitudes, for example.

P053 - Distinct but interacting neural mechanisms underlying conscious face identification and conscious face detection

Shen-Mou Hsu [1], Catherine Tallon-Baudry [2], Yu-Fang YANG [1]

[1] Research Center for Mind, Brain and Learning, National Chengchi University, Taipei, Taiwan (R.O.C.), [2] Cognitive Neuroscience Laboratory, Institut National de la Santé et de la Recherche Médicale (INSERM) – École Normale Supérieure (ENS), Paris, France.

How an external piece of information gains access to conscious processing has been one of the central issues in the literature. Much of previous progress has focused on distinguishing different states of conscious access, with the emphasis on how brain activity differentially responds to perceptual aware and unaware stimuli. However, according to the hierarchical view of stimulus representations, a face, for instance, has at least two levels of representations, ranging from a low-level representation of facial features to a high-level representation of facial identities. By capitalizing on the hierarchical contents of face stimuli, in this study, participants were instructed to view a briefly presented masked face from trial to trial while MEG activity was recorded. Behaviorally, the participants were able to recognize the identity of the faces (conscious face identification) in some trials, but were only able to detect the presence of the faces (conscious face detection without identification) in other trials. The MEG results showed that these two levels of conscious access depended on distinct spatio-temporal-frequency patterns of phase clustering. However, further analysis revealed that the phase adjustment tuned for conscious identification interacted with the phase adjustment tuned for conscious detection. Altogether, these findings suggest that different levels of conscious perception are not accessed in a fully independent manner, but conscious face identification is built upon the success of conscious face detection.

P054 - The puzzle about particularity of perceptual content and a deeper question

Ting-An Lin [1]

[1] Department of Philosophy, Texas Tech University Consciousness Research Group, Taiwan.

The “indistinguishability phenomenon” and the “veridicality requirement” of perception seem to pull us into opposite directions when concerned with the nature of perceptual content. While there are some proposals to the puzzle about particularity, I shall argue that the proposals reveal to us deeper questions about the relationship between the experiential part and the representational part of perceptual content and we should answer this deeper question in order to treat the puzzle about particularity properly. Two proposals to the puzzle about particularity discussed in this paper are the multiple-contents thesis and Soteriou's theory. Both proposals suggest a distinction between the experiential part and the representational part of perception and try to explain the indistinguishability phenomenon by the experiential part and to meet the veridicality requirement by the representational part. They also agree that (1) the representational part is object-involved while experiential part is not and (2) two perceptual experiences with different representational parts can have the same experiential part. However, what is the relationship between the two parts? I suggest that a version of vehicle-based representationalism can help us with this question. I shall argue that the representational part is determined by what is

appropriately involved in the perceptual experience and the experiential part is the determined by the representing relation between the intentional content and the perceiver. According to vehicle-based representationalism, the phenomenal properties are identical to the properties of representing intentional content. During both veridical and hallucinatory cases, the perceiver stands in the same representing relation to the same intentional content. The same representing relation thus leads to the same experiential part between veridical and hallucinatory cases. In veridical cases, the external object is perceived by the perceiver in virtue of representing the intentional content and thus involves into the representational part, while in hallucinatory cases, there is no particular object involved. The representational part thus makes us to say that we perceive the very object in veridical cases and we can perceive the very same object with other perceivers.

P055 - Parietal TMS and binocular rivalry: stimulus and timing dependence resolve contradictory findings

Georg Schauer [1,2,4], David Wood [3,4], Thomas Bak [1], Dave Carmel [1]

[1] School of Philosophy, Psychology and Language Sciences, University of Edinburgh, Scotland, [2] Sackler Centre for Consciousness Science, University of Sussex, England, [3] Institute for Adaptive and Neural Computation, School of Informatics, University of Edinburgh, Scotland, [4] Authors contributed equally to this study.

Binocular rivalry occurs when dissimilar images are presented to corresponding retinal locations in the two eyes: Rather than a combined image being perceived, one image dominates awareness while the other is suppressed, and dominance switches periodically. This bistable phenomenon is useful for investigating conscious awareness, as sensory stimuli remain constant while awareness changes. Neuroimaging studies have shown that activity in the right anterior superior parietal lobule (SPL) is time-locked to perceptual switches in rivalry. Further transcranial magnetic stimulation (TMS) studies established this region's causal role in rivalry by showing that stimulating it altered switch rates. However, the effects found in different studies were contradictory: TMS either shortened or lengthened rivalry durations. Here, we replicate both findings and show under which conditions each occurs. Participants underwent parietal and vertex (control) TMS both before viewing binocular rivalry (offline) and while viewing rivalry (online). Each combination of stimulation location and timing was delivered in a separate session; session order was randomised. In each session, dominance durations were compared with a baseline measured before stimulation. In Experiment 1, the rivalrous stimuli were orthogonal gratings. In Experiment 2, the stimuli were pictures of a face and a house. In both experiments, offline parietal (but not vertex) stimulation shortened dominance durations compared to baseline, as in previous studies. Neither experiment found an effect of online stimulation when comparing stimulation to baseline, but in Experiment 2, direct comparison of online-parietal and online-vertex dominance durations (as done in a previous study using similar face/house stimuli) showed lengthening under parietal stimulation. The differential effects of offline and online stimulation are consistent with offline stimulation inhibiting neural activity and online stimulation increasing noise; our findings thus support the view that right anterior SPL mediates maintenance of current expectations about ambiguous stimuli rather than generating switches. The finding that online TMS lengthens dominance for face/house but not grating stimuli demonstrates a previously unreported stimulus-dependence for the effect of TMS in rivalry, suggesting that such stimulation may alter interactions between stimulus-specific regions and a parietal selection mechanism.

P056 - Contextual cueing of visual search alters conscious perception of spatial configurations

Bernhard Schlagbauer [1,2], Manuel Rausch [1,2], Michael Zehetleitner [1], Hermann J. Müller [1,3], Thomas Geyer [1]

[1] Department Psychologie - Ludwig-Maximilians-Universität München - Germany, [2] Graduate School of Systemic Neurosciences - Ludwig-Maximilians-Universität München - Planegg-Martinsried - Germany, [3] School of Psychology - Birkbeck College - University of London - United Kingdom.

In visual search, repeated exposure to spatial configurations of distractor items facilitates search behaviour by formation of a long-term memory representation of spatial context, an effect termed contextual cueing. This phenomenon is widely regarded as an implicit effect, without any subjective insight into the acquired memory or the changes in behaviour. The current study addresses the question whether the acquired spatial memory representation or the improvement in visual search due to configural learning is available to conscious access and metacognition. In two experiments, we investigated the effect of configural learning on metacognitive reports of the perceptual experience of the display configuration and the target stimulus. A Bayesian analysis revealed that repeating search displays was associated with an increase of metacognitive sensitivity of subjective experience of the display configuration, indicating metacognitive access to the memory underlying contextual cueing. By contrast, metacognitive access to the target stimulus was unaffected from repeated context. We conclude that metacognitive processes are informed by spatial memory of the distractor configurations during contextual cueing, but not by the facilitation of visual search. This suggests that metacognitive access to spatial long-term memory in contextual cueing is strongly content-specific.

P057 - Consistent Individual Differences in Suppression Breaking Speed in Continuous Flash Suppression

Asael Y. Sklar [1], Ran R. Hassin [1,2]

[1] The Hebrew University of Jerusalem, Department of Psychology, [2] The Hebrew University of Jerusalem, Center for the Study of Rationality.

Identifying consistent individual differences in central constructs such as intelligence or working memory is one of the psychology's greatest contributions. Here, we report a new trait affecting the contents of our consciousness. In Experiment 1 fourteen participants were presented with emotional faces (sad, happy and neutral) in a breaking suppression Continuous Flash Suppression task (bCFS). Participants' suppression breaking speed (SBS) was strongly correlated between the different facial emotions ($r=0.93$, $p<0.001$; $r=0.96$, $p<0.001$; and $r=0.94$, $p<0.001$; for happy-sad, happy-neutral and sad-neutral). Importantly, there was also a strong correlation between the eyes, $r=0.92$, $p<0.001$, indicating that eye-specific individual differences cannot account for the differences in SBS. In Experiment 2, twenty four participants first completed a categorization task in which they categorized stimuli as houses or faces, and then completed a bCFS task with stimuli from the same categories. In both tasks either houses or faces were more frequent (80% of trials), varied between participants. The correlation between frequent and infrequent stimuli's SBS was high, $r=0.86$, $p<0.001$, and remained high when RTs to frequent and infrequent stimuli in the conscious categorization task were partialled out, $r_{\text{partial}}=0.86$, $p<0.001$. In Experiment 3, forty three participants completed two blocks of a bCFS task with arithmetic statements followed by two blocks of a control condition in which the same stimuli were presented binocularly, superimposed over the mask. SBS in the two bCFS blocks was highly correlated, $r=0.84$, $p<0.001$, and remained so when RT in the control blocks was partialled out, $r_{\text{partial}}=0.86$, $p<0.001$. In Experiment 4 we pushed the boundaries further, by examining whether individual differences in SBS are stable across time. Sixteen participants completed two bCFS tasks approximately fifteen minutes apart. SBS was highly correlated across time, $r=0.82$, $p<0.001$, thus suggesting high stability. SBS was highly stable in all experiments regardless of stimuli type, which eye was masked, participants' expectations, and time. The correlation is unaffected by a statistical control for average RT in both a general task and a control condition in which participants search for the same stimuli over the same masks without the suppression. We therefore conclude that SBS is a stable individual trait that affects one of the most important determinants of human behavior: our consciousness.

P058 - The role of recognition in shaping neural category representations

Anouk M. van Loon [1,2] Iris I.A. Groen [1,3], Johannes J. Fahrenfort [2], Victor A. F. Lamme [1,4] & H. Steven Scholte [1,4]

[1]Department of Brain and Cognition, University of Amsterdam, 1018 XA, Amsterdam, The Netherlands, [2]Department of Cognitive Psychology, VU University, 1081 BT, Amsterdam, The Netherlands, [3]Laboratory of Brain and Cognition, National Institute of Mental Health, National Institutes of Health, Bethesda, MD20892, Maryland, USA, [4]Amsterdam Brain and Cognition, University of Amsterdam, 1018 WS, Amsterdam, The Netherlands.

Recognizing and categorizing objects is an important aspect of consciousness perception. Using multi-voxel pattern analysis (MVPA) it is possible to decode category specific information of objects based on their neural representations. Previous research suggests that neural category representations might already arise from bottom-up unconscious input, whereas object recognition does requires top-down information. Therefore, we investigated the effect of recognition on shaping neural category representations in object-selective cortex using fMRI. We manipulated object recognition by converting the images of two categories - animate and inanimate - in two-tone Mooney images. Mooney images are hard to recognize when never seen before, yet are easily recognized after a greyscale version of it has been shown. Therefore, were presented the Mooney images in two phases: before and after the presentation of its greyscale version. Our results demonstrate that recognition was not required for the animate / inanimate categorization in object-selective cortex, since this categorization was already apparent during the first Mooney phase. Recognition did however increase the animate / inanimate categorization for the second Mooney phase. Basic-level categorization (e.g. fish vs cat) was only apparent for the greyscale images. We speculate whether differences in low-level images statistics between the two categories may explain some of our results. Overall, these findings suggest that animate / inanimate category selective responses in object-selective cortex can arise based on the physical properties of the images independent of recognition whereas perceptual or object basic-level identification responses do require recognition and depend on top-down processing.

P059 - Why the single state conception does not solve the problem of phenomenal unity

Wanja Wiese [1]

[1] Johannes Gutenberg University Mainz (GER) Department of Philosophy.

The problem of phenomenal unity (PPU) is the following: What is the difference between experiencing two events separately and experiencing them together? According to the common single state conception (SSC) of phenomenal unity, two events are experienced together just in case the corresponding phenomenal states are both part of a single phenomenal state (cf. Bayne, 2010). In this paper, I will present the following argument against SSC: 1. Progress on PPU can only be made a) by giving a phenomenological characterization of the difference between phenomenal unity and disunity, or b) by suggesting an operational definition of phenomenal unity. 2. SSC offers a mere redescription of the problem containing neither (a) nor (b). 3. Therefore, it does not promote progress on PPU. Ad 1a): A phenomenological characterization of the difference between phenomenal unity and disunity can, for instance, be provided by giving examples in which events are experienced together (or separately). Baumann (2007) contrasts the example of a person who smells and tastes a rotten egg with the case of a person who smells gasoline and tastes chocolate. In the first case, there is a crossmodal congruence between smell and taste that constitutes a phenomenal difference to the second case. As Deroy (2014) points out, in the rubber hand illusion, consciously seeing and feeling synchronous stroking of the real and the rubber hand can go along with an experienced “drift [...] toward the location of the seen hand” (2014, p. 113), which is absent in asynchronous conditions. Such examples clarify the difference between unity and disunity (by a phenomenal contrast, cf. Siegel, 2007), and thus promote progress on PPU. Do the phenomenal differences have anything in common? SSC does not address this question, because it does not characterize any *phenomenal* differences. Ad 1b): Another option is to start with operational definitions of phenomenal unity, e.g., in terms of behavioral differences (as in studies on the split-brain syndrome), and then to try and determine whether such behavioral differences really go along with a phenomenal difference. Reformulating PPU in terms of phenomenal states (as suggested by SSC) does not facilitate an operational definition, because

counting phenomenal states on the basis of behavioral or neural data comes with its own problems (cf. the debate in Bayne, 2000; O'Brien & Opie, 1998, 2000). This shows that SSC does not constitute a fruitful approach to PPU.

P060 - Physiological Markers of Human Conscious Visual Perception

Wendy R Xiao [1], Rachel E Smith [1], George T Touloumes [1], Sarah S Weiss [1], Rebecca E Watsky [1], William C Chen [1], Jason L Gerrard [2], Dennis D. Spencer [2], Hal Blumenfeld [1, 2, 3]

[1] Neurology, [2] Neurosurgery, [3] Neurobiology, Yale University, New Haven, CT.

Many behavioral tasks seek to understand the neural differences underlying identical stimuli that are consciously perceived versus not consciously perceived. Advance imaging and electrophysiology techniques can be used to reveal the temporal propagation and whole-brain anatomy of brain areas involved in processing a stimulus into conscious awareness to allow subsequent report of the stimulus. We have developed a visual threshold perception behavioral paradigm that produces brief conscious events which we probed by subsequent report of perception and validated by report of location. We used a face stimulus with contrast titrated to each individual subject's threshold perception levels so they perceive it only 50% of the time. We then recruited 7 patients from the Yale Epilepsy Surgery Program with some 100-300 implanted intracranial electrodes sampled at 1024 Hz to perform this task. For trials in which a stimulus was present, stimuli were perceived 55% ($\pm 3\%$ SEM) of the time. In trials in which no stimulus was present, the false positive rate was 18% ($\pm 6\%$ SEM). When a subject reported perceiving a stimulus, they were able to correctly locate the stimulus in 1 of 4 quadrants 87% ($\pm 3\%$ SEM) of the time compared to only 28% ($\pm 3\%$) when they indicated not perceiving the stimulus. We therefore know that subjects are appropriately performing the task. In our electrocorticography analysis, we contrasted trials in which the stimulus was perceived and correctly located ("confirmed perceived") with trials in which the stimulus was not perceived and incorrectly located ("confirmed not perceived"). We find that primary visual cortex event-related potentials (ERPs) appear identical for images that are perceived and not perceived, whereas higher visual processing areas and fronto-parietal association areas show clear divergence in signals as early as 200 ms until at least 1000 ms post-stimulus. Preliminary event-related time-frequency analyses indicate that slower, later latency ERPs may also show high-frequency (80-120 Hz) power changes, which suggest concomitant higher-order cognitive processing. Overall, our results suggest that state-related fluctuations in the brain may amplify identical incoming signals from the primary visual cortex to allow conscious perception at times but not others. Further analysis of pre-stimulus intervals may identify the mechanism of the signal amplifications and reveal network-related changes during brief conscious events.

SLEEP AND DREAMS

P061 - The phenomenology of dreaming: a multi-theoretical approach

Alessio Bucci [1], Matteo Grasso [2]

[1] Independent Researcher, University of Edinburgh Alumnus, [2] Roma Tre University.

Despite the advancements in the study of sleep, many doubts still remain with regard to the phenomenal aspects of dreaming. Sleep mentation seems to lack a solid evolutionary explanation and we have no precise mapping of the phenomenal aspects of dreaming onto the neural activity of the sleeping brain. In order to address these issues, we propose to adopt Predictive Processing (PP), an emerging theoretical framework for cognitive science that aims to unify perception, action and cognition under a single mechanism (Clark 2013, in press; Hohwy 2013). The core idea is that brains are predictive machines with a hierarchical structure, continuously in the business of predicting their own sensory inputs. Applied to the study of dreaming (Hobson & Friston 2012, Hobson, Hong & Friston 2014), PP highlights the continuity and the differences of dreaming with other waking mental states, grounding them on the very same cognitive architecture. However, PP doesn't precisely account for the phenomenological aspects and how we come to experience anything in the first place (the "hard

problem” of consciousness). We argue that if a second theory proves to be efficient in explaining the phenomenal aspect of dreaming, then PP could be integrated with it for a more comprehensive explanation of cognition. Our theory of choice is Integrated Information Theory (IIT) (Tononi 2012, Oizumi, Albantakis & Tononi 2014). According to IIT the quantity of consciousness of a system is equal to the amount of integrated information generated by its elements, while the quality of experience is defined in relation to maximally irreducible conceptual structures (MICS), i.e. constellation of concepts in the “qualia space”. Phenomenal consciousness is hence defined on the basis of the informational relationships generated by the system's repertoire of internal states, which characterizes conscious experience in both the waking and dreaming state. After the introduction on PP, IIT and the specific issues surrounding dreaming, we proceed to explain how PP and IIT can be merged in order to explain the cognitive mechanism behind the emergence of dream phenomenology, focusing on the conceptual similarity between the two theories' vocabularies. Finally, we illustrate a few critical points and some implications of a more general merging of the theories.

P062 - Awareness of Bizarreness and Cognitive Abilities in Dreams: A Qualitative Study

Ming-Ni Lee, Chi-Han Huang [1], Yu-Siou Jhan [1], Yi-Chieh Lai [1], Po-Yuan Hu [1], Te-Sen Wang [1]

[1] National Dong Hwa University, Taiwan, R.O.C.

The present research was intended to explore reflective awareness and cognitive components in dreams, especially for awareness of bizarreness, memory, rational thinking/anticipation, and other potential aspects of lucid dreaming (including attention and intentionality, etc.). Ninety undergraduate students, who took the introductory psychology class at a Taiwanese university, were the participants (28.1% females, 71.9% males, mean age = 19.0 years) of this study. Participants provided a dream report regarding their most impactful dream during the preceding three months. Following this dream report, a series of open-ended questions (19 questions in total) were designed to obtain further in-depth information regarding the different aspects of reflective awareness and cognitive components in dreams. Based on the content analysis approach, four trained raters independently completed their coding tasks. The results suggested that 35.6% dream reports were categorized as lucid dreams; also, the frequency of volitional control within lucid dreams was higher than that of staying mindfulness in lucid dreams. However, the occurrences of lucid dreaming were not significantly accompanied with other evidence of cognitive abilities in dreams. On the other hand, the majority of dream reports (66.7%) involved awareness of bizarreness in the dream; in addition, awareness of bizarreness was found accompanied with higher depersonalization and higher rational thinking/anticipation (with unsettled feeling and tension). To some extent, the finding in this study was not consistent with results suggested by previous studies, and this might indicate the restriction due to ratings based on a third-person point of view. The implications of this study will be further discussed.

P063 - Which kind of waking life events are incorporated into dreams ?

Raphael Vallat [1], Benoit Chatard [1], Perrine Ruby [1]

[1] Centre de Recherche en Neurosciences de Lyon - Université Lyon 1.

Several studies in experimental psychology suggest that the content of dreams is influenced by the waking life of the dreamer (Blagrove & Pace-Schott 2010; Ruby 2011). However, the rules constraining the incorporation of waking-life events into dream are still unclear. To investigate this issue, we will ask participants (40 high dream recallers) to record their dreams with a Dictaphone immediately after waking up for 7 days. After the recording, subjects will be asked to identify and characterize in their dream(s) elements reminding them an event/situation experienced during waking life. If dreams are involved in memory consolidation, one would expect that event incorporated into dreams would be novel and recent rather than familiar and remote. If dreams are involved in emotional regulation and problem solving (Barrett 1996, 2001; Cartwright 2010) one would expect that dreams incorporate more negative than positive events and more important than trivial events.

P064 – Detection of arithmetic violations during sleep

Melanie Strauss [1], Stanislas Dehaene [1,2,3]

[1] Cognitive Neuroimaging Unit, NeuroSpin Center, Commissariat à l'Energie Atomique, Institut National de la Santé et de la Recherche Médicale, U992, F-91191 Gif/Yvette, France, [2] Department of Life Sciences, Université Paris 11, 91400 Orsay, France, [3] Chair of Experimental Cognitive Psychology, Collège de France, F-75005 Paris, France.

Does the sleeping brain remain capable of manipulating numbers? Some characteristics of the arithmetic computation are possible in non-conscious states, as magnitude or semantic representations. We then tested the brain capabilities in detecting arithmetic violations during sleep. We auditory presented normal subjects with simple arithmetic operations (additions, multiplications and subtractions). The arithmetic results were correct or not. The subjects were either awake and attentive to the nature of the result (correct or not), either awake but inattentive to the nature of the result, or asleep. We recorded cerebral responses to correct versus false results in electro and magnetoencephalography. The awake and attentive subjects showed activations in temporal and anterior areas for all kind of operations, from around 300ms after the result. In the awake but inattentive condition, those effects were not present: only late activations around 600ms were observed when combining all the types of operations. During sleep, surprisingly, activations were stronger than in the inattentive condition. Significant effects were found for additions and multiplications, at similar latencies than during the attentive wakefulness. However, topographies were different, suggesting different or incomplete mechanisms during sleep. The sleeping brain remains capable of detecting arithmetic errors in simple additions and multiplications. These results suggest that the brain seems able to detect arithmetic violations during sleep for an overlearned content. However, as no significant effect was seen for subtractions, it may be unable to really calculate the operation. In any case, it is striking that the sleeping brain better perform in detecting simple arithmetic violations than the awake but inattentive brain, maybe related to residual attentive capabilities during sleep.

P065 - Macrostructure and microstructure of sleep in High and Low dream recallers and evoked potentials to auditory arousing stimuli presented during sleep

Raphael Vallat [1], Jean-Baptiste Eichenlaub [1], Dominique Morlet [1], Perrine Ruby [1]

[1] Centre de Recherche en Neurosciences de Lyon - Université Lyon 1.

According to Schredl et al. (2008), the mean dream recall frequency (DRF) is approximately 1 dream report per week. Yet, the DRF can vary widely between individuals; some persons report a dream almost every morning while others rarely report one. Identifying the critical parameters influencing DRF is an important step to progress in our understanding of the mechanism and possible function of dreaming. In the present research, we reanalyzed data of Eichenlaub and al. (2014) to investigate more precisely the macro and micro -structure of sleep in High dream-recallers (HR) and Low dream-recallers (LR), and also to measure ERPs to arousing vs non-arousing stimuli during sleep. Our results show that intra sleep awakenings are both more frequent and longer in HR than in LR, regardless of sleep stages. By contrast, preliminary results suggest no between groups difference in arousal. Further parameters of the sleep microstructure and ERPs to arousing stimuli remain to be analysed.

P066 - Artificial neural networks – a promising tool for sleep staging in healthy individuals and clinical populations

Tomasz Wielek [1], Julia Lechinger [1,2], Malgorzata Wislowska [1,2], Renate Del Giudice [1,2], Christine Blume [1,2], Helmut Mayer [3], Manuel Schabus [1,2]

[1] Laboratory for Sleep, Cognition and Consciousness Research, University of Salzburg, Salzburg, Austria, [2] Centre for Cognitive Neuroscience (CCNS), University of Salzburg, Salzburg, Austria, [3] Neurodynamic and Neurosignaling Group, University of Salzburg, Salzburg, Austria.

Sleep cycles in patients suffering from disorders of consciousness (DOC) have been proposed to be indicative of the preserved residual brain functions (e.g. Blume et al., 2015). However, reliable and valid characterization of the unusual sleep patterns in this clinical group continues to be challenging for neuroscientists. The main difficulties encountered are absence of well-defined EEG changes or sleep criteria and frequent and extended artifacts in clinical recordings. In the present study, we address both of these issues and investigate the usefulness of artificial neural networks (ANN) in handling the nonlinearity of patients EEG while permutation entropy (PE) was employed to measure complexity of the EEG signal irrespective of noise. The potential of an ANN-PE-based classifier to differentiate between sleep and wake as well as different sleep stages was first validated on healthy subjects (15 subjects, 8h recording for each). The results show a high accuracy (about 80%) for within subject classification (i.e. ANN trained and tested on the same subject), and moderate accuracy (about 65%) for generalized classification (i.e. ANN trained on several subjects and tested on a different data set). The use of multiple electrodes at different locations also allowed for a comparison of the predictive value of PE for classification at different electrode sites. Results suggest that the PE fluctuations on frontal electrodes are a good predictor of wake state and deep sleep. Currently, the classifier trained and optimized on healthy subjects is applied to patient data and contrasts wake from sleep stages. In conclusion, ANN using PE as input data may provide a new and promising approach for sleep stage classification in healthy subjects, but also for classifying real “sleep” in DOC patients. Further optimization strategies for implementing our approach in the analysis of DOC data will comprise the application of unsupervised learning algorithms and incorporation of the PE dynamics (time-course data). The project is supported by a grant from the Austrian Science Fund FWF (Y-777). Blume, C., del Giudice, R., Wislowska, M., Lechinger, J., & Schabus, M. (2015). Across the consciousness continuum—from unresponsive wakefulness to sleep. *Front Hum Neurosci*, 9, 105.

P067 - Circadian changes of EEG brain activity in patients with disorders of consciousness

Malgorzata Wislowska [1,2], Renata del Giudice [1], Julia Lechinger [1], Nicole Chwala-Schlegel [1], Steven Laureys [3] & Manuel Schabus [1,3,4]

[1] Laboratory for Sleep, Cognition and Consciousness Research, University of Salzburg, Austria & Centre for Cognitive Neuroscience Salzburg (CCNS), Salzburg, Austria, [2] The University of Nottingham, School of Psychology, Nottingham, United Kingdom, [3] Coma Science Group, Cyclotron Research Center and Neurology Department, University of Liege and University Hospital of Liege, Liege, Belgium, [4] Centre for Cognitive Neuroscience Salzburg (CCNS), Salzburg, Austria.

People, who survive severe brain injuries and subsequently recover from coma, progress through different disorders of consciousness (DOC) states, like the Vegetative State (VS) or the Minimally Conscious State (MCS). Integrity of brain functions in these patients can be estimated by observing naturally occurring circadian changes (like sleep-wake cycles) as well as based on the presence of various brain oscillations. In the present study we therefore tried to further elucidate associations between behavioural signs of consciousness and circadian changes in EEG patterns. Continuous 24h PSG data was recorded from DOC patients. We included in our analyses data from two samples of patients recorded in Austria (9 VS and 7 MCS) and Belgium (12 VS and 10 MCS). The recordings were separated into day-time and night-time sequences and were carefully cleared from artefacts (movements, nursing, physiotherapy, family visits, etc.). Thereafter, we used automatic scripts to detect sleep specific EEG patterns: (i) slow and fast sleep spindles as well as (ii) slow oscillations. We used non-parametric statistics to compare features of sleep spindles (density, mean frequency as well as mean activity) and of slow oscillations (ratio of negative and positive length, amplitude as well as density)

– (i) between day-time and night-time sequences, as well as (ii) between VS and MCS patients. We found that in MCS patients mainly fast sleep spindles recorded from fronto-central sites are changing over the 24h period. In both samples we found density as well as mean frequency (Hz) to be increased during night-time in these patients. In VS patients on the other hand, we did not find significant changes. When comparing groups we additionally found that sleep spindles were found to be of higher frequency and density only during the night-time. With regards to slow oscillations, we failed to observe any significant variations between day and night periods. Yet when comparing VS and MCS patients, we consistently observed higher peak to peak amplitude of slow oscillations in MCS patients, both during day- as well as night-time. Our data suggests that while sleep spindles measures may constitute an interesting index of recovered sleep-wake cycles, slow oscillations appear to be more closely related to the diagnosis rather than to circadian changes. Generally, the presence of sleep EEG elements can be indicative for the retained integrity of specific brain areas.

SYNESTHESIA

P068 - Database of Synesthetic Color Associations for Japanese Kanji

Daisuke Hamada [1], Hruna Kawasaki [1], Hiroki Yamamoto [1], Jun Saiki [1]

[1] Graduate School of Human and Environmental Studies, Kyoto University, Japan.

Synesthesia is a neurological phenomenon where certain types of stimuli elicit involuntary perceptions in an unrelated pathway. A common type of synesthesia is grapheme-color synesthesia, where visual perception of letters and numbers stimulates perception of a specific color. Previous studies have often collected relatively small numbers of grapheme-color associations per synesthete, but accumulation of a large quantity of data has greater promise for uncovering the mechanisms underlying synesthetic association. In this study, we therefore collected large samples of data from five synesthetes: over 1000 synesthetic colors associated with Japanese kanji characters from each of two synesthetes and about 80 synesthetic colors associated with Japanese hiragana, Latin letters, and Arabic numerals from each of three synesthetes. We then compiled the data into a database, called the KANJI-Synesthetic Colors Database (K-SCD), which has a total of 3829 colors for 483, 46, and 46 Japanese kanji, hiragana, and katakana characters, respectively, as well as 26 Latin letters, and 10 Arabic numerals. In addition to introducing the K-SCD, this paper demonstrates the database's merits using two examples, in which two new rules for synesthetic association, "shape similarity" and "synesthetic color clustering," were found. The K-SCD is publically accessible (<http://www.cv.jinkan.kyoto-u.ac.jp/site/uploads/K-SCD.xlsm>) and will be a valuable resource for those who wish to conduct statistical analyses using a rich dataset in order to uncover the rules governing synesthetic association and to understand its mechanism.

P069 - Color Processing in Grapheme-Color Synesthetes: Color Processing in Grapheme-Color Synesthetes: An Attentional Blink ERP Study

Christian Gaulty [1], Michael Pitts [1], Enriqueta Canseco-Gonzalez [1]

[1] Reed College, Portland OR, USA.

When grapheme-color synesthetes are presented color patches preceded by achromatic letter primes, they are slower to name the color patch when it is incongruent with the synesthetic color induced by the prime. When the achromatic letter primes are rendered invisible via backward masking, however, this synesthetic congruency effect disappears, suggesting that synesthetic color processing may not occur in the absence of awareness. The present study utilized event-related potentials (ERPs) as a more sensitive measure of unconscious color processing in grapheme-color synesthetes. Conscious perception of grapheme stimuli was manipulated via the attentional blink paradigm. Distractor stimuli were grey false fonts, target 1 (T1) was one of four oriented gabor patches, and target 2 (T2) was one of four different letters or one of four different false fonts (both printed in black). Following the rapid stream of stimuli (presented at 10Hz), a task-irrelevant color patch was presented, the color of which was either congruent or incongruent with the (pre-determined) synesthetic color association of T2. ERPs

elicited by T2 were compared between letters and false fonts and ERPs to the color patch were compared between congruent vs. incongruent trials. For synesthetes, the seen letters vs false fonts contrast revealed a positive-going ERP wave over fronto-central scalp sites, approximately 170ms after stimulus onset. This positivity was not observed in matched controls. For incongruent vs congruent color patches that followed seen letters, a negative-going ERP wave over fronto-central scalp sites, approximately 200ms after stimulus onset, was apparent only in synesthetes. Both of these synesthetic color effects were absent for trials in which participants are unaware of T2, during the attentional blink. Overall, these findings suggest relatively early (170ms) stages of synesthetic color processing that depend on awareness of the grapheme inducer.

P070 - Synaesthesia is associated with a distinct metacognitive profile

Andy D Meador [1], Jamie Ward [1,2]

[1] School of Psychology, University of Sussex, Brighton, UK, [2] Sackler Centre for Consciousness Science, University of Sussex, Brighton, UK.

People with grapheme-colour (GC) synaesthesia experience additional quasi-perceptual colour experiences in the presence of letters or numbers. Recent work has shown that GC synaesthesia is often associated with a memory benefit, mainly linked to materials which induce synaesthetic experience, or linked to the concurrent experience itself (i.e. colours or visual materials more generally). Due to this richer world of experience, we conducted two studies asking whether GC synaesthesia would also impact on metacognition for memory. In Experiment 1, GC synaesthetes and control participants completed an old/new recognition task, using different material modalities: Numbers, complex achromatic visual materials, and short musical passages. We also collected confidence ratings. GC synaesthesia was associated with better memory performance – as measured by d' – across all modalities, and response criterion c did not differ by group. GC synaesthesia was also associated with higher type II D' across all modalities, likely driven by higher d' . Critically, confidence bias – as measured by type II C – was lower in GC synaesthetes than controls, specifically for numbers. Thus synaesthetes were more confident recognising inducing materials, but not other materials. In Experiment 2, GC synaesthetes, sequence-space (SS) synaesthetes and controls completed a continuous word recognition task. SS synaesthetes consciously experience visual arrays for ordinal sequences, but critically should not experience synaesthesia for unrelated words. Participants were shown words consecutively and were asked to endorse those they had already seen during the experiment. Again, confidence ratings were taken. GC, but not SS, synaesthesia was associated with a metacognitive benefit as shown through confidence-accuracy correlations. Thus, changes in metacognition were limited to inducing materials. This is the first study we are aware of to examine the metacognitive profile of GC synaesthesia. Using two different metacognitive measures, the current experiments suggest that additional quasi-perceptual experiences associated with synaesthesia impact on metacognitive memory processes.

P072 - Second-order mappings between acoustic properties and visual experience in a timbre-to-sight synesthete: a case study

Nicholas Root [1], Vilayanur S. Ramachandran [1]

[1] University of California, San Diego.

In sound-sight synesthesia, sounds trigger involuntary visual experiences, such as percepts of color. While a synesthete's own sound-sight mappings are usually consistent over time, the mappings across synesthetes are usually idiosyncratic: to Synesthete A, a violin's sound is always pink; to Synesthete B, it is always turquoise. However, even though these first-order mappings are idiosyncratic, it is possible that there are consistent second-order mappings across synesthetes: Synesthete A might experience red-hued colors for all stringed instruments, and Synesthete B might experience blue-hued colors for all stringed instruments. Here we describe a series of psychophysics experiments on a timbre-sight synesthete, LB, for whom sounds evoke visual percepts of colored objects. We found second-order relationships between the acoustic properties of a sound and the colors and objects that it evokes. First,

we analyzed LB's instrument-color associations, and found that instruments that are closer together in a multidimensional timbre space evoke colors that are closer together in CIELUV space. Next, we synthesized sounds with systematically-varying timbral properties, and succeeded in systematically changing the shape and location of LB's object percept. Finally, we compared LB's performance on a timbre categorization task to the performance of both typical controls and trained musicians. LB deduced the task-relevant timbre dimension more quickly than either control group, and achieved a higher categorization accuracy than the controls, despite being unable to describe a difference in her acoustic percepts (she could only describe a difference in her evoked visual percepts). Together, these results suggest that LB's synesthetic associations are heavily influenced by the acoustic properties of the sounds that evoke them. We suggest that quantifying second-order associations in a larger group of timbre-sight synesthetes might someday yield insights into the representational structure of timbre in the brain.

P073 - Synaesthesia as a model problem for the scientific study of consciousness

Noam Sagiv [1]

[1] Centre for Cognition and Neuroimaging, Brunel University London, United Kingdom

Cross-modal interactions are prevalent in perception. However, in individuals with synaesthesia, such interactions occur when only one sense is stimulated, resulting in a perceptual experience in two or more sensory modalities. I will argue that synaesthesia could be used as a model problem for the scientific study of consciousness and provide insights into such problems as individual differences in conscious experience and the possibility of inverted spectra, the neural correlates of consciousness, construction of the perceived world, and even mentalising – how we understand other minds. I will demonstrate how this approach works in practice, concluding that different variants of synaesthesia may provide us with a series of test cases for hypotheses concerning conscious perception.

Thursday, July 9th
(16:00 – 17:30)

ALTERED STATES OF CONSCIOUSNESS - I

P074 - EEG characteristics of music processing and the effect of music on cognitive processes in comatose and post-comatose patients

Maïté Castro [1], Lizette Heine [2], Barbara Tillmann [1], Florent Gobert [1], Alexandra Corneillie [1], Frédéric Dailler [3], Nathalie André-Obadia [4,5], Jacques Luauté [6,7], Fabien Perrin [1]

[1] Auditory Cognition and Psychoacoustics Team – Lyon Neuroscience Research Center (UCBL, CNRS UMR5292, Inserm U1028), Lyon, France, [2] Coma Science Group, Cyclotron Research Center and Neurology Department, University and University Hospital of Liège, Liège, Belgium, [3] Department of Intensive Care, Neurological Hospital, Hospices Civils de Lyon, France, [4] Clinical Neurophysiology Unit, Neurological Hospital, Hospices Civils de Lyon, France, [5] Central Integration of Pain in Humans – Lyon Neuroscience Research Center (UCBL, CNRS UMR5292, Inserm U1028), Lyon, France, [6] Integrative, Multisensory, Perception, Action and Cognition Team – Lyon Neuroscience Research Center (UCBL, CNRS UMR5292, Inserm U1028), Lyon, France, [7] Department of Physical Medicine and Rehabilitation, Henry Gabrielle Hospital, Hospices Civils de Lyon, France.

Improving the sensitivity of clinical tests is a major clinical challenge for patients with disorders of consciousness (DOC). Some studies in patients with DOC have shown that the use of stimuli that are salient for the patient increases the probability to observe a cerebral response. In addition, music can be a highly familiar and emotional stimulus that conveys beneficial effects on cognitive processes in both normal and pathologic cerebral functioning. The present study aimed to evaluate, in comatose and post-comatose patients, whether exposure to the patient's preferred music could improve cognitive functions; in particular, the processing of a significant stimulus, the patient's own name, as compared to a control condition. In this study, an auditory oddball paradigm that uses the patient's own first name and seven unfamiliar first names, was performed in 30 patients with DOC. Each sequence of first names was preceded either by a preferred musical piece in the music condition or by a continuous sound in the control condition. At the same time, we recorded EEG signals from 13 electrodes. The event-related potentials analysis showed that the cerebral discriminative response to the patient's first name (N2 and/or P3) was observed more frequently in the music condition than in the control condition. Indeed, the presentation of preferred music enhanced the probability to obtain a N2 or/and P3 to the patient's own name. We also performed a frequency analysis during the exposure to the patient's preferred music and to the continuous sound in order to relate frequency characteristics during the exposure period with the presence or absence of the event-related potentials. Moreover, we investigated the potential correlation between the presence vs. absence of the discriminative response to the patient's first name in the music condition and the outcome of patient 6 months later. The cerebral response to the patient's first name obtained in the music condition, coupled with the frequency analysis of music processing, become a sensitive clinical tool to enhance the detection of cognitive functions in patients with DOC and to predict patients' recovery.

P075 - Trace conditioning during acute coma and hypothermia

Elsa Juan [1,2], Nathalie Ata Nguenpjo Nguissi [1], Athina Tzovara [1], Dragana Viceic [3], Marco Rusca [4], Mauro Oddo [5], Andrea O. Rossetti [2], Marzia De Lucia [1]

[1] Laboratoire de Recherche en Neuroimagerie (LREN), Department of Clinical Neurosciences, Lausanne University Hospital and University of Lausanne, Lausanne, Switzerland; [2] Neurology Service, Department of Clinical Neurosciences, Lausanne University Hospital and University of Lausanne, Lausanne, Switzerland; [3] Neurology Service, Hôpital du Valais, Sion, Switzerland; [4] Department of Intensive Care Medicine, Hôpital du Valais, Sion, Switzerland; [5] Department of Intensive Care Medicine, Lausanne University Hospital and University of Lausanne, Lausanne, Switzerland.

Associative learning using classical trace conditioning refers to the ability of learning the contingency between a neutral stimulus (conditioned) and a salient one (unconditioned) separated by a temporal gap. This form of learning is typically believed to require awareness of the contingency between the stimuli. Recent studies challenged this view by providing evidence of trace conditioning in vegetative and minimally conscious state patients and in healthy individuals during sleep. In the present study we

investigated whether associative learning induced by trace conditioning can be observed during coma. We included 29 comatose patients treated with therapeutic hypothermia (TH) after cardiac arrest, recorded on the first days of coma. We presented auditory sequences where a neutral tone (conditioned stimulus, CS+) was typically followed by an alarm (unconditioned stimulus). In few trials, CS+ was presented alone in order to test whether it could elicit a neural response similar to that of the alarm. Sounds were presented at the bedside via earphones while recording 19 channels electroencephalography (EEG). EEG signal was analyzed through a decoding algorithm at the single recording level. All patients were clinically evaluated for their level of consciousness using the FOUR score at the moment of the recording. We first evaluated which patients exhibited a reliable neural response following the presentation of the alarm; we then tested the existence of a similar neural response to that of the alarm (i.e. replay) following the CS+ alone. Among the 29 patients recorded, 13 were recorded twice (i.e. during TH and during the second day at normal temperature (NT)), 1 was recorded 3 times (once during TH and on two different days during NT) and 15 were recorded once (8 during TH and 7 during NT). Fourteen patients exhibited a reliable evoked response to the alarm. Within them, five patients exhibited evidence of a replay effect following the CS+ alone: 3 of them during TH and 2 during NT. All patients were deeply comatose (FOUR score between 0-4). Our results provide a first evidence of trace conditioning in post-anoxic coma and challenge the notion that consciousness is required for learning association between sensory stimuli.

P076 - Repeated left prefrontal tDCS in patients with chronic minimally conscious state: a sham-controlled randomized double-blind study

Thibaut Aurore [1], Bruno Marie-Aur lie [1], Wannez Sarah [1], Donneau Anne-Francoise [2], Martial Charlotte [1], Laureys Steven [1]

[1] Coma Science Group, Cyclotron Research Center, university of Li ge & Department of Neurology, University Hospital of Li ge, Li ge, Belgium, [2] D partement des sciences de la sant  publique, Informatique m dicale et biostatistique, university of Li ge.

Background: A recent study showed that single-session anodal transcranial direct current stimulation (tDCS) applied to the left dorsolateral prefrontal cortex (LDLPF) transiently improves consciousness in 43% of patients in minimally conscious state (MCS) (1). We here test the potential effects and safety of repeated tDCS in severely brain-damaged patients with MCS. Methods: In this double-blind cross-over sham-controlled experimental design, we delivered two sessions of repeated (5 days of stimulation) tDCS, either anodal or sham in a randomized order. We stimulated the LDLPF cortex (Figure 1) during twenty minutes in 20 MCS patients (12 men, aged 48±16 years, time since onset 78±95 months, 12 post-traumatic). Consciousness was assessed by the French adaptation of the Coma Recovery Scale Revised (CRS-R; 2) before and after each stimulation (Figure 2)...

P077 - Depression as a ‘hyperordinary’ state, and the antidepressant mechanisms of non-ordinary states of consciousness

Paul Liknaitzky [1], Jakob Hohwy [2], Nicholas Allen [3]

[1] Melbourne School of Psychological Sciences, University of Melbourne, [2] Philosophy Department, Monash University, [3] Department of Psychology, University of Oregon.

Whilst depression has been associated with increased default mode network activation, a range of non-ordinary states of consciousness – such as those generated through mindfulness and psychedelics – show the opposite pattern. Moreover, depression has been linked to numerous cognitive features that relate to default thinking, such as increased self-salience alongside relational isolation, decreased sensory processing and increased abstract rumination, reduced suggestibility, perceived meaninglessness, and cognitive rigidity. In contrast, non-ordinary states are typically associated with reduced self-salience alongside relational inclusiveness, increased sensory processing, hypersuggestibility, perceived meaningfulness, and cognitive flexibility. Furthermore, various non-ordinary states produce antidepressant effects, although therapeutic mechanisms are poorly understood. Central to this contrast, self-oriented and endogenous factors appear more influential in depression, while exogenous factors have a greater influence in non-ordinary states. Here, I present the

Hyperordinary Depression Hypothesis, a novel states-of-consciousness account of depression that draws on converging lines of evidence to show how excessive default thinking and endogenous control is central to the development of the disorder, and antithetical to core features of non-ordinary states. We tested this hypothesis using a novel expectancy-violation-processing paradigm that assesses the balance between endogenous and exogenous influences on higher-order cognition. For the first time, we found a link between depression and deficits in processing unexpected higher-order information. These deficits may represent a mechanism for a core cognitive feature of the disorder: the persistence of distorted beliefs. We are currently exploring whether these deficits extend to more basic unconscious levels of processing using a Continuous Flash Suppression paradigm which measures the time taken for expected versus unexpected stimuli to enter awareness. These findings will be presented in the context of depression aetiology, the antidepressant mechanisms of non-ordinary states, and novel therapeutic prospects arising from this reconceptualization.

P078 - Can transcranial direct current stimulation facilitate motor performance in the absence of training? Therapeutic implications for the vegetative state

Kathleen Lyons [1,2], Adrian Owen [1,2], Davinia Fernández Espejo [1]

[1] Brain and Mind Institute, University of Western Ontario, [2] Psychology Department, University of Western Ontario.

Although vegetative state patients are considered to be not aware, some patients are covertly aware, but unable to show it with external motor behavior (Fernández-Espejo & Owen, 2013). Previous work has suggested that the lack of voluntary motor control in these patients may be due to a structural disruption in the motor system (Fernández-Espejo et al., under review). Targeted interventions to enhance the functionality of this system could therefore assist in partially restoring motor responsiveness in this group. Transcranial direct current stimulation (tDCS) is a non-invasive brain stimulation technique, which uses weak electrical currents to modulate cortical excitability (Jacobson et al., 2012). Previous studies have shown that anodal tDCS, which enhances cortical excitability, can improve performance on motor learning tasks (Saucedo Marquez et al., 2013; Waters-Metenier et al., 2014). Moreover, tDCS has shown promising effects in rehabilitating motor functioning in several neurological groups, such as stroke patients (Lefebvre et al., 2015; Stagg et al., 2012). However, such studies typically rely on extensive training and providing feedback to the participants. Consequently their results cannot be easily extrapolated to vegetative state patients, as providing effective feedback to these patients is particularly challenging (Chatelle et al., 2012). The main aim of this study was to investigate if tDCS can facilitate motor performance on a random sequence motor reaction time task, without training or providing feedback. Forty healthy participants were randomly assigned to receive sham or anodal tDCS, as well as to perform the task with or without training (in a cross-sectional 2 by 2 factorial design). Participants were presented with random digits (1-4) on a computer screen, and asked to respond by pressing the corresponding keys on the keyboard as quickly as possible. All participants completed a 5 minute baseline task, 20 minutes of tDCS over the primary motor cortex (with anodal stimulation or sham), and a 5 minute post-tDCS task. In the training condition, participants also practiced on this task for 20 minutes. In the non-training condition, they watched a 20 minute video instead. The results will be discussed in terms of their implications for designing an effective tDCS protocol to assist in restoring motor function in covertly aware vegetative patients.

P079 - A new ERP paradigm to improve the detection of voluntary processes in behaviorally unresponsive patients at bedside

Dominique Morlet [1,2], Perrine Ruby [1,2], Nathalie André-Obadia [2,3,4], Catherine Fischer [1,2,3]

[1] INSERM U1028, Lyon Neuroscience Research Center, Brain Dynamics and Cognition Team, 69675 Bron cedex, France, [2] Université Lyon 1, Lyon, France, [3] INSERM U1028, Lyon Neuroscience Research Center, Central Integration of Pain in Human Team, 69677 Bron cedex, France, [4] Hospices Civils de Lyon, Hôpital Neurologique P.Wertheimer, Service de neurophysiologie et d'épileptologie, Bron, France.

Paradigms requiring voluntary participation of the subject (perform mental imagery or count targets) have been recently introduced to evidence brain signals (EEG or fMRI) reflecting covert consciousness in behaviorally unresponsive patients. We designed a new EEG paradigm for better detection of willful modulations of attention at patient's bedside. A standard auditory oddball paradigm was used. After passive listening, subjects were asked to actively divert their attention (using a mental imagery task) and to actively focus their attention (counting the stimuli). Results from 20 healthy subjects show that the contrast between diverted and focused attention was larger than between passive listening and focused attention. The difference between focused and diverted attention was significant for standard and deviant stimuli, at the group level and at the individual level. Preliminary results show that this protocol can evidence voluntary processes in unresponsive patients.

P080 - Agency and automatic responding: Hypnotic alterations to conscious control

Vince Polito [1] , Amanda Barnier [1]

[1] ARC Centre of Excellence in Cognition and its Disorders, Macquarie University, Sydney, Australia.

Sense of agency - the sense we have of controlling our actions - is an integral part of our conscious experience that allows us to distinguish events or sensory consequences that we have caused from those that are externally generated. Most of the time this sense is obvious and uncontroversial. There are situations, however, where sense of agency is reduced or breaks down completely. Striking cases of agency reduction can be found in clinical conditions such as alien control delusions and in certain symptoms of schizophrenia, such as passivity phenomena. A reduction in the sense of agency is also a defining characteristic of hypnosis: high hypnotisable participants routinely describe their actions during hypnosis as occurring without effort or conscious intention. The capacity of highly hypnotisable participants to respond in this way has led researchers to develop functional models of psychopathology involving hypnotic suggestions for cognitive and perceptual alterations based on the specific features of clinical conditions. I will report on a study in which the features of clinical delusions of control were modelled to alter participants' sense of agency for automatic actions. Wegner, Fuller & Sparrow (2003) found that participants were unable to suppress correct responding in a trivia quiz when instructed to respond randomly. In a hypnotic adaptation of this task, I gave participants suggestions based on clinical accounts of alien control and thought insertion delusions as alternative strategies for responding in an equivalent trivia quiz. Participants given the thought insertion suggestion answered many more trivia quiz questions correctly, although they were unaware of doing so. Participants given the alien control suggestion were able to suppress correct responding and gave random answers in the trivia quiz. These results demonstrate the ability of hypnosis to alter participants' insight into their own actions and for carefully worded hypnotic suggestions to lead to changes in otherwise uncontrollable behaviours. These findings are consistent with clinical reports of agency disruption and highlight the utility of hypnosis as a model of altered cognitive functioning in healthy participants.

P081 - Meditators can't ignore what's right in front of them

Rebecca Semmens-Wheeler [1, 2], Zoltan Dienes [2]

[1] University of Northampton, [2] Sackler Centre for Consciousness Science.

Meditation has been associated with improved metacognitive skills, such as mindfulness. Because meditation involves training of focus on one's mental states, it was hypothesised that experienced meditators would be poorer at ironic control than an age-matched group of non-meditators. Twenty meditators and seventeen age-matched non-meditators looked at a sequence of images during two fifteen minute sessions. During one session, the 'ignore' condition, participants were told to avoid looking at the images directly in front of them. During the 'attend' condition, they are told to keep thinking of the images. During each session, they were asked at random intervals (roughly once a minute) whether they were just that instant before aware of seeing the image. Meditators were worse at ironic control than non-meditators; they reported thinking of the images when they were told to ignore them significantly more than the control group. Therefore, the results suggest that mediators are poorer than non-meditators at ironic control.

DECISION

P082 - Awareness of commodity prices activates consumers' purchase hesitation during decision making

Katsuhiko Arihara [1], Atsunori Ariga [1], Takeshi Furuya [1]

[1] Risscho University.

Tversky and Kahneman (1981) reported that most participants decided to drive when they can save money on a low-price relative to a high-price good, even though the discount price was same. Although this irrational decision making has been interpreted as our rate-dependent estimation of value, this study proposes that it can be explained by purchase hesitation in response to reference price of goods. Experiment 1 replicated the previous rate-dependent effect, and also demonstrated that participants expressed more hesitation to purchase a high-price than a low-price good. When it was emphasized that participants' intention to purchase high- and low-price goods were equally sure, the rate-dependent effect was eliminated (Experiment 2). Furthermore, decision making was manipulated only by purchase hesitation specified differently for the same-price goods (Experiment 3). Consumers' decision making is rather rational, depending on purchase hesitation that is susceptible to reference price.

P083 - How can a science of agency inform automation design

Kevin Le Goff [1,2], Patrick Haggard [3], Arnaud Rey [2], Bruno Berberian [1]

[1] Systems Control and Flight Dynamics Department, ONERA, Salon de Provence, France, [2] Laboratoire de Psychologie Cognitive – CNRS Aix-Marseille University, Marseille, France, [3] Institute of Cognitive Neuroscience University College London, United Kingdom.

Over the past 50 years, automation technology has profoundly changed our everyday life. Nowadays, the influence of automation is ubiquitous. While the public is generally enthusiastic about the potentialities offered by automation technology, recent tragedies remind us of the difficulties that human operators have in supervising highly automated systems. Particularly, when the automatic equipment fails, human supervisors seem effectively helpless at diagnosing the situation, determining the appropriate solution and retaking control. This set of difficulties is called the Out Of the Loop (OOL) performance problem. Although such difficulties have been identified for a long time, clear solutions are still missing to overcome them. Here, we outline the potential of collaboration between neuroscience and ergonomics to understand and compensate for such difficulties. Particularly, we assume that the recent explosion of interest in the experience of being an agent ("agency") opens interesting novel

avenues to address the OOL performance problem. In this presentation, we will first summarize the difficulties encountered by human operator in interaction with automated systems. Then we will discuss how automation technology could dramatically change our experience of agency and present relevant empirical data. After introducing the societal issues raised by such transformations of agency (safety, acceptability, ethics, penal), we show two experiments that apply the framework of agency to the OOL problem in a Human-Machine Interface situation. Using an aircraft supervision task, we show that the principles suggested by recent studies of sense of agency make useful design suggestions for acceptable and more controllable automated interfaces. In particular, by using feedback to alert the operator to the current intention of the system, we demonstrate that human operators can react more effectively in the case of unexpected situations. To conclude, we propose that the concept of agency has the potential to inspire future research and the development of new automated technologies.

P084 - “Deciding advantageously with some consciousness of the advantageous strategy”

Cristobal Ignacio Dañobeitia Morong [1]

[1] Universidad Autonoma del Estado de Morelos. Facultad de humanidades Cuernavaca. Mexico.

Bechara et al 1997, showed how normal subjects choose advantageously before knowing the strategy in a game that mimics real life decisions. (Maia et al. 2004) compare a control group replicating the original design of (Bechara et al.1997) and a questionnaire condition to refine methods. The results showed that the advantageous decisions behaved similarly between the control group and the questionnaire group in time. The questionnaire group showed more awareness of the strategy and being more consistent with the dynamics of behaviour than original condition Methods on a standard version of Iowa gambling (2 good decks and 2 bad decks). Control condition C replicating methodologies (Bechara et. al 1997) and an Eliciting Interview condition EI (Petitmengin 2006), will be comparing. EI is a semi-structured interview to make first-person reports so that individuals focus their attention on the deployment of the action in time, rather than in their beliefs being able to access more level of consciousness about the advantageous strategy that condition C. We refine the category equivalence of level of consciousness of the strategy made by (Maia et.al 2004) to comparisons. Nametags of level of consciousness were converted to numerical values in a 0 to 5 scale. Advantageously behaviour is how many cards you take from decks C and D. The interviews are transcribed blind to the experiment and numerical values for level of consciousness are categorized under a double -blind evaluation (Froese, 2013). Preliminary results on 3 subjects per condition we find no significance difference in average between conditions related to the numbers of card selected for the good decks EI; 52,5 – C 46,6. A difference of 6 cards is not significant at a confidence interval between (-1.669) and (9,869) from an estimated 95 % of reliability. Qualitative graphics shows easily, how the behaviour on C and EI has a similar dynamic matching over trial marks. Contrary, average of level of consciousness of the strategy are very different per condition; EI 2,95 and C 1,40 in a scale between 0 to 5. In total average EI condition rich up to Hunch category of consciousness about the strategy and C rich to partial hunch category. Also subjects don't show frequently conceptual consciousness of the strategy like Bechara 1997 argues. The increment of consciousness doesn't evidence continuity. Many subjects under the two conditions go back in the final trials to more basics levels of consciousness.

P085 - Neural Implementation of Model-based Inference and Mental Simulation

Kenji Doya [1], Akihiro Funamizu [1]

[1] Neural Computation Unit, Okinawa Institute of Science and Technology Graduate University.

Mental simulation is a critical brain function that allows humans and some animals to perform model-based inference, planning, and decision making. Recent functional brain imaging and lesion studies suggest the involvement of some cortical areas, such as the posterior parietal cortex and the prefrontal cortex, in decisions utilizing action-dependent state transition models. However, it is still unclear how

such internal model-based inference is realized by the neuronal circuit of the cerebral cortex. Here we propose a hypothesis on the implementation of model-based state estimation and action planning in the cortical microcircuit. In sensory cortical columns, we assume that firing of layer 5 pyramidal neurons represent the posterior probability of a certain state of the environment. The bottom-up sensory input through layer 4 drives layer 2/3 pyramidal neurons, which represent the likelihood of the state represented by the column given the sensory input. The inter-columnar horizontal connections between layer 5 neurons as well as the feedback connections through higher cortical areas to the apical dendrites implement a state transition model to compute a predictive prior probability. Layer 5 pyramidal neurons integrate the prior probability with the likelihood signal from layer 2/3 neurons given near the cell body through multiplicative interaction of dendritic calcium spikes and back-propagating action potentials. Recurrent inhibition by interneurons normalize the posterior probability signal represented by layer 5 pyramidal neurons. Some inhibitory interneurons in the sensory cortex are known to receive motor information, which may contribute to action-dependent modulation of state transition models through disinhibition of lateral connections. The duality between Bayesian sensory estimation and optimal motor control suggests that a similar circuit architecture can be used for action planning as well. We propose an experimental approach to test this hypothesis using recent optical neural imaging technologies.

P086 - “Knowing how much” affects the reward effects on executive inhibition

Paula M. Herrera[1,2,3], Alberto Velez Van Meerbecke [2] , Mario Speranza[1,4], Claudia Lopez Cabra[2], Mauricio Bonilla [3], Adam Hampshire [5] and Tristán A. Bekinschtein [6]

[1] EA4047 (HANDIReSP), Université de Versailles Saint Quentin en Yvelines, France, [2] Grupo de investigación en neurociencias (NeURos), Universidad del Rosario, Colombia, [3] Laboratorio de psicología experimental, Universidad El Bosque, Colombia, [4] Department of Child and Adolescent Psychiatry, Centre Hospitalier de Versailles, France, [5] Division of Brain Sciences, Imperial College London, UK, [6] Department of Psychology, University of Cambridge, UK.

The Stop Signal Task (SST) is a suitable model to explore cognitive inhibition. Inhibitory control implies the ability to dynamically modify or cancel planned action. This dynamical dimension on the inhibition is crucial to make possible the flexibility of the cognitive control system, a landmark of conscious processing. SST allows measuring the stop signal reaction time (SSRT). Recent studies have shown SSRT may vary due to subtle manipulations as the cost of inhibition errors through punishment, monetary rewards, or learning. In a Stop Signal Task (n=45) modulated by task instructions participants received different reward magnitudes in one of two groups: the Primed group knew in advance the possibility to obtain different rewards, and the Unprimed group, who were unaware of reward differences. Our results suggest that inhibition processes are not only affected by reward magnitudes, but also by the expectation of reward. Being conscious, or not, of the presence of diverse rewards, seems to play a crucial role on the inhibition behavioral adjustment under motivational cues. Moreover, and beyond the influence of the reward itself, our results also suggest other subtle effects given by the knowledge of the reward size, and the expectation of the reward outcome. Furthermore, our results are consistent with predictive coding account of the brain, based on a bayesian system that allows for an optimal prediction of outcomes to modulate behavior. Finally, we think that our Stop Signal Task protocol (with EEG recordings) may be applied on normal or pathological populations with a double aim: a better understanding of the expectancy effects on neural processes of reward, and a better understanding of the physiopathological underpinnings of some psychiatric conditions as ADHD, gambling or personalities disorders.

P087 - Beliefs, Values and Confidence in human decision-making

Marion ROUAULT [1], Jan DRUGOWITSCH [2], Etienne KOEHLIN [1]

[1] Laboratoire de Neurosciences Cognitives INSERM U960, Ecole Normale Supérieure, Paris, [2] Département des Neurosciences Fondamentales, Université de Genève.

Executive control relies on the evaluation of action outcomes for subsequent action. Action outcomes, however, may convey two types of value signals:

- Affective values (Av), representing the valorisation of outcomes over a continuum of subjective preferences

- Informational values (Iv), modulating subjects' belief about the appropriate action in a given situation. Av stems from reinforcement learning (RL), whereas Iv stems from Bayesian models. Previous experimental paradigms usually confounded Av and Iv: a higher reward usually informs about more appropriate choices. Here we present a probabilistic reversal learning task aiming at dissociating Av from Iv. Healthy human subjects had to decide between two shapes, one of which was more frequently rewarded than the other one. The potential rewards to gain for each shape were displayed before each choice. Crucially, we manipulated the reward distributions underlying each shape to dissociate Av from Iv. We developed a computational model of monitoring and decision, integrating two parallel systems: RL, dealing with Av, and Bayesian inference, dealing with Iv. This model fitted behavioral performance better than many alternative models. BOLD signal was then regressed against linear and quadratic effects of both beliefs and affective values under the following interpretations. Anterior cingulate cortex (ACC) activity varied negatively with both relative chosen belief and relative chosen affective value, meaning that ACC activity decreased when chosen value increased, which reflects the evidence accumulation process for decision. Ventromedial prefrontal cortex (vmPFC) activity correlated positively with both relative chosen belief and relative chosen affective value, meaning that vmPFC activity increased when chosen value increased, which reflects expectations associated with chosen shape. A region showing a positive quadratic effect was more activated when both beliefs/values were far from each other, which corresponds to unsigned pre-choice preferences or a post-choice confidence signal (more confidence when both beliefs/values are away). We found a double-dissociation between vmPFC and ACC; with ACC specific to affective values, while vmPFC was specific to beliefs. Such a pattern demonstrates a separate monitoring of beliefs and affective values. These belief and confidence signals could contribute to the brain implementation of metacognitive processes.

P088 - A dynamic interplay between awareness and weighting of sensory evidence during human decision making

Simon van Gaal [1,2], Valentin Wyart [3], Jun Jiang [1], Stanislas Dehaene [4], Floris de Lange [2]

[1] University of Amsterdam, Dept of Psychology, Netherlands, [2] Radboud University Nijmegen, Donders Institute for Brain, Cognition and Behavior, Netherlands, [3] Laboratoire de Neurosciences Cognitives, INSERM Unit 960, Département d'Etudes Cognitives, Ecole Normale Supérieure, PSL Research University, 75005, France, [4] Inserm, Cognitive Neuroimaging Unit, Gif-sur-Yvette, France.

Human decisions are based on accumulating evidence over time for different options. We have recently shown that this accumulation process depends on the awareness level of the presented stimuli: awareness drastically changes decision making, by biasing the evidence accumulation process. Here we followed up on this work and examined the influence of awareness on decision making over time using both behavioral methods and magneto-encephalography (MEG). Participants were required to make decisions by accumulating evidence over a series of five visually presented numbers whose visibility was modulated by masking. Behavioral results showed that participants could accumulate evidence under both low- and high visible conditions. However, crucially, our results revealed that low-visible information was clearly underweighted when presented in combination with high visible evidence (mixed visibility condition), compared to pure low-visible conditions in which all five stimuli were low visible. To account for these findings, we described the effects of “visibility context” on decision making using a computational model which assumes that decision noise arises from noise corrupting the evidence samples. The model has three parameters: the amount of noise for processing low- and high-visible evidence, irrespective of the condition, and a “weight” parameter which controls the relative impact of low-visible evidence on decisions in the mixed visibility condition. Bayesian model selection revealed that an underweighting of the low-visible evidence was able to explain human choice behavior in the mixed visibility condition. These results suggest that early sensory processes are unaffected by the “visibility context”, but that late inference processes are, resulting in a relative “blindsight” to the low-visible evidence in the subsequent decision. The observed pattern of results could not be explained by a gain model indicating that subjects were not processing the evidence differently in the pure and mixed visibility conditions. We are still in the process of analyzing the MEG data and can hopefully present some of those results too.

EMOTION - I

P089 - Fear conditioned visual information gains preferential access to consciousness

Surya Gayet [1], Chris L. E. Paffen [1], Artem V. Belopolsky [2], Jan Theeuwes [2], & Stefan Van der Stigchel [1]

[1] Department of Experimental Psychology, Utrecht University, Utrecht, Netherlands, [2] Department of Cognitive Psychology, VU University, Amsterdam, Netherlands.

The present study aimed at investigating whether fear conditioned visual information gains preferential access to consciousness. We used visual stimuli with no intrinsic relevance (colored rings) and associated one of them with aversive stimulation (electric pulses) following a fear conditioning procedure. Participants were then informed that they would not receive any more electric pulses. We subsequently measured the duration that these stimuli remained invisible under continuous flash suppression, a method derived from binocular rivalry. This revealed that stimuli that were previously paired with an aversive stimulus, and thus signaled threat, broke through suppression faster than stimuli that were not paired with an aversive stimulus. In a separate experiment, we demonstrated that a physical increase in luminance produced the exact same pattern of results. Thus, visual information that signals threat is prioritized for conscious access, by increasing its subjective signal strength.

P090 - Interoception modulates fear breakthrough in binocular rivalry

Cassandra D. Gould [1,2], Gabriel Hassan [3], Ryan B. Scott [1,2,3], Sarah Garfinkel [1,2] and Hugo D. Critchley [1,2]

[1] Department of Psychiatry, Brighton and Sussex Medical School, Brighton, UK; [2] Sackler Centre for Consciousness Science, University of Sussex, Brighton, UK; [3] School of Psychology, University of Sussex, Brighton, UK.

Interoception is the body-to-brain axis of sensation concerning the state of the internal body and its visceral organs, including the heart. We employ a binocular rivalry paradigm in which stimulus presentation is locked to specific phases of the cardiac cycle, to determine the impact of internal cardiac signalling and interoceptive awareness on the perception of ambiguous emotional stimuli. Participants ($n = 33$) were presented with luminance matched fearful and neutral faces, through dichoptic viewing apparatus. Fear faces were initially degraded to 10% contrast, and then modulated using a 1 down/1 up staircase over 20 reversals, to determine a stable contrast at which the fear face was perceived in a minority of trials. Two interleaved and independent staircases were run with stimulus presentation locked to 1) cardiac systole, 2) cardiac diastole. Results show a significant interaction between cardiac phase and interoceptive accuracy in the detection of fear faces, such that those with high interoceptive accuracy had a reduced breakthrough contrast at systole ($M = 19\%$) compared to those with low interoceptive accuracy ($M = 26\%$) ($F(1, 27) = 4.27$, $p = .048$). Furthermore, metacognitive insight into interoceptive ability (i.e. interoceptive awareness) significantly predicted breakthrough contrast of fear faces across both systole and diastole, with increased interoceptive awareness associated with breakthrough at lower contrast levels. Heightened sensitivity to fear at systole, as a function of interoceptive accuracy, extends recent demonstrations of an up regulation of fear processing at cardiac systole. Specifically, we demonstrate a perceptual dominance of fear stimuli at systole in individuals who are objectively good at detecting their own heartbeat. In contrast, the relationship between interoceptive awareness and fear breakthrough suggests that agreement between objective and subjective interoceptive abilities leads to enhanced sensitivity to fear stimuli irrespective of cardiac modulation. Together these results support the role of interoceptive dimensions in shaping emotional responses, and show that the detection of fearful stimuli is enhanced in individuals who are more attuned to bodily responses.

P091 - Experiencing the pain of others: The link between somatosensory cortex hyperactivity and conscious mirror-pain experiences

Thomas Grice-Jackson [1,2], Hugo D. Critchley [1,3], Jamie Ward [1,2]

[1] Sackler Centre for Consciousness Science, University of Sussex, United Kingdom, [2] Department of Psychology, University of Sussex, United Kingdom, [3] Brighton and Sussex Medical School, Brighton, United Kingdom.

For most individuals the observation of others in pain (vicarious pain) does not elicit a conscious experience of pain in the observer; however, some individuals regularly experience vivid conscious vicarious pain (known here as mirror-pain responders), and a significant portion of the general population report these experiences occasionally. Through the development of an online screening questionnaire the current study presents a method for identifying and profiling the experiences of mirror-pain responders. These individuals and a group of controls were then recruited for an EEG experiment which assessed suppression of ~10Hz somatosensory cortex alpha oscillations, mu-suppression (known to reflect somatosensory cortex activity), during image observations of human hands and feet either experiencing pain or no pain (neutral). The findings display greater levels of mu suppression during both image conditions in mirror-pain responders relative to controls. Critically, mirror-pain responders showed increased mu-suppression during pain image observations relative to neutral images. No such difference between pain and neutral images were observed for the control group. This suggests that the conscious experiences of vicarious pain may be due to generally increased hyperactivity of the somatosensory cortex with specified hyperactivity when observing pain. Additionally, correlations between mu-suppression and measures from the online questionnaire indicate a link between increased somatosensory activity and an increased tendency to localize conscious vicarious pain experiences to a particular point on the observer's own body (as opposed to generalized bodily pain). Finally, increases in the level of mu suppression was related to increases the participant's perceived pain sensitivity, measured using the pain sensitivity questionnaire. Indicating that vicarious pain processing may, in part, rely on one's own experiences with physical pain.

P092 - Mood-congruent memory bias, response bias and metacognition

Aleksandra Gronostaj [1], Borys Paw Paulewicz [2], Agata Blaut [3]

[1] Affiliation Faculty of Pedagogy, Pedagogical University of Cracow, [2] Affiliation University of Social Sciences and Humanities, Campus in Katowice, [3] Affiliation Institute of Psychology, Jagiellonian University.

Mood-congruent memory is considered to be a robust phenomenon in depression. Unfortunately it is typically observed only in recall tasks which makes it difficult to say if this effect is due to the differences in encoding, retention, biased covert candidate items generation at the recall stage or the response bias. In order to shed some light on these issues we tested the effects of affect on recall of negative, positive and neutral words when the recall was preceded by the separate overt candidate items generation stage and when the recollections were rated on a metacognitive scale. After filling the PANAS questionnaires the participants rated the valence of randomly chosen emotional words. Later they engaged briefly in the filler task. After completing the filler task the participants in the control group were instructed to recall as many items as possible without time limit. In the generation-recognition group the participants were required to write down any negative and positive words that came to their mind, regardless of whether they were presented before. It was only after the generation stage that they were instructed to recognize these words as old or new. In the metacognitive judgement group the recall stage was not preceded by the generation stage but the participants were instructed to rate the recalled words according to how certain they were that the words were actually presented in the memory set. The results show the usefulness of metacognitive measurement in this context.

P093 - Transcranial Ultrasound ('TUS') at 2 MegaHertz to Right Prefrontal Cortex Improves Mood in Healthy Volunteers

Stuart Hameroff [1,2], Joseph L. Sanguinetti [2], Ezra Smith [2], Lauritz Dieckman [2], John J. B. Allen [2]

[1] Department of Anesthesiology, Center for Consciousness Studies, Banner-University Medical Center, The University of Arizona, Tucson, Arizona, [2] Department of Psychology, University of Arizona, Tucson, Arizona

Non-invasive brain stimulation modalities include TMS, tDCS and transcranial ultrasound (TUS). Previous human studies showed 15 seconds of sub-thermal TUS delivered to right fronto-temporal scalp is painless and imperceptible during exposure, and enhances mood and sensory discrimination for up to an hour. Here we report two double blind studies in human volunteers with a GE LOGIQ ultrasound imaging device. Subjective mood before and after TUS was measured with the Visual Analogue Mood Scales (VAMS) from which an aggregate Global Affect (GA) score was calculated. In Experiment 1 (N=38) we compared 15 sec TUS to right pre-frontal cortex at 2 MHz vs 8 MHz, and found 2 MHz resulted in significantly improved GA 15 minutes and 30 minutes post TUS. In Experiment 2 (N=38) we compared 15 sec TUS to right pre-frontal cortex vs sham/placebo, and again found 2 MHz TUS improved mood by GA 15 min and 30 min post TUS. As mood reflects subjective experience, the TUS mechanism has implications for the science of consciousness. Other studies have shown TUS induces ipsilateral gamma synchrony EEG, and that megahertz stimulation promotes assembly, stability and resonance of cytoskeletal microtubules inside neurons. TUS holds promise for safe, painless non-invasive treatment of mood, neurological and cognitive disorders. And as TUS selectively alters mental states, understanding its mechanism offers a unique perspective in the scientific study of consciousness.

P094 - ERP and behavioral evidence of increased sensory attenuation for fear related action outcomes

Gethin Hughes [1]

[1] Department of Psychology, University of Essex, United Kingdom.

Voluntary action selection entails the representation of the expected consequences of the action. Previous evidence suggests that accurate action-effect prediction modulates both ERP and behavioural markers of sensory processing – a phenomenon known as sensory attenuation. This may play an important role in monitoring the success or failure of our actions, or attributing agency. Nonetheless, the vast majority of studies in this domain focus on simplistic visual and auditory stimuli. Given that we rarely perform voluntary actions with the aim of generating such stimuli in social contexts, this provides little indication of the extent to which sensory attenuation operates in everyday behaviour. The present study investigated ERP and behavioural measures of sensory attenuation for fearful and neutral facial expressions. Participants were trained to associate one voluntary action with the presentation of a fearful face, and another action with a neutral face. We measured both ERP responses and behavioural ratings following presentation of faces whose emotional content was either consistent or inconsistent with the action prediction. We observed significant modulation for fearful outcomes only, suggesting that sensory attenuation is heightened to stimuli of high social relevance. The N170 response was significantly attenuated for congruent fearful faces, but not for congruent neutral faces (in comparison to incongruent faces). Similarly, behavioural ratings were modulated only for fearful faces but not neutral faces. This provides new insight into how social and affective outcomes modulate sensory attenuation and has implications for implicit sense of agency for socially relevant stimuli.

P095 - Reducing pain by moving through space? Influence of real versus illusory self-motion perception on pain thresholds and pain evoked potentials

Lucian M. Macrea [1], Gianluca Macaudo [2], Giovanni Bertolini [2], Dominik Straumann [2,3], Peter Brugger [2,3], Konrad Maurer [1], Antonella Palla [1], Bigna Lenggenhager [2,3]

[1] Pain Research Unit Institute of Anesthesiology University Hospital Zurich University Zurich Switzerland, [2] Neurology Department University Hospital Zurich Switzerland, [3] Zurich Center for Integrative Human Physiology University of Zurich Switzerland.

Vestibular signals play an important role in determining one's own body motion and orientation, in spatial navigation and in building and maintaining a coherent sense of a bodily self. Several clinical observations suggest a complex interaction between vestibular processes, nociception, and the sense of the bodily self (e.g. André et al. 2001; Balaban 2011; 2014; McGeoch et al. 2008). Furthermore, recent evidence suggests that vestibular signaling increases pain thresholds in healthy participants (Ferre et al. 2012), using non-physiological vestibular stimulation (i.e. cold caloric vestibular stimulation). Here we investigated whether vestibular stimulation might alter subjective pain perception in healthy participants using a rotating chair. As signals from vestibular system are integrated with signal from other motion-sensitive sensory system (e.g. vision), we additionally test visually induced illusory self-motion (i.e.vection) to separate the effect of a general motion stimulus from that of a vestibular stimulus on pain processing. We performed quantitative sensory testing (QST) for the following parameters: thermal detection thresholds for the perception of cold and warm, thermal pain thresholds for cold and for heat (e.g. Maier 2010). The QST measurements were performed at baseline, during vestibular stimulation (chair rotating with sinusoidal stimuli in three different frequencies: 0.1, 0.3 and 0.7 Hz) as well as during leftwards and rightwardsvection and a comparable visual random dots movement. We included 17 healthy male volunteers (mean age=35.4 years, mean BMI=23kg/m²) with normal QST values. Our data show a significant difference between baseline and all other conditions (rotating chair and illusory self-motion) for the warm perception threshold, cold perception threshold and heat pain threshold (Friedmann tests, all p values < 0.0003, as data were not normally distributed). No difference was found between the different experimental conditions. These results point towards a rather non-specific effect of motion stimuli. This finding is compared and discussed in the framework of previous studies in the field of pain processing.

P096 - Seeing emotion where there is none: contextually induced emotion perception is similar to the perception of real emotional expressions

Marte Otten [1], Jim Parkinson [1], Anil K. Seth [1]

[1] Sackler Centre for Consciousness Science, Sussex University, Brighton, UK.

Does the frown on your supervisors face mean she is disapproving or thinking? We know from experience that social perception is often a construct. To interpret social stimuli, the perceiver combines sensory input with the wider social context and stored knowledge of the social world. Models of perception based on hierarchical prediction suggest that such top-down not only shape 'late' interpretation of sensory input: rather, contextual predictions ('priors') could also influence early sensory perception. Applied to social perception, this suggests that social context could modulate the earliest stages of perceptual processing of social stimuli. We tested this hypothesis using Event-Related Potentials (ERP). Participants read sentences that described positive, happiness-inducing events ("She just sold her house for a big profit.") or negative, anger-inducing events ("She lost all her pictures when her computer crashed."). Each critical sentence was followed by a face with a neutral emotional expression. Behavioural pretests showed that participants rated neutral faces following the positive sentence as happier than identical neutral faces presented in isolation, while neutral faces following negative sentences were rated as angrier. If this context-induced percept of emotion is the result of contextual predictions directly shaping visual processing, then the early ERP components related to visual perception should show similar modulation for real-emotion faces and induced-emotion faces. If, on the other hand, the experience of the induced expressions is the result of later integration of the sensory input within the social context, then effects related to the early visual processing of the real-emotion faces should not be present in the induced-emotion faces. Our ERP results showed that real-

anger faces evoked a larger N1 compared to real-happiness faces, followed by a larger negativity at around 170 ms for real-happiness faces compared to real-anger faces. These effects were equally present for the induced-anger and induced-happiness faces. This shows that social contextual cues, such as positive and negative events, directly shape early visual processing of social stimuli. Our results indicate that social predictions may play an essential role in the way we perceive the world.

P097 - The voice of anger: Emotional prosody across the consciousness continuum

Manuel Schabus [1,2], Renata del Giudice [1,2], Christine Blume [1,2], Julia Lechinger [1,2], Malgorzata Wislowska [1,2], Maria-Teresa Gnjeczda [1], Kerstin Hoedlmoser [1,2]

[1] Laboratory for Sleep, Cognition and Consciousness Research, Department of Psychology, University of Salzburg, Salzburg, Austria, [2] Centre for Cognitive Neuroscience Salzburg (CCNS), University of Salzburg, Salzburg, Austria.

Minimally Conscious State (MCS) and Vegetative State are two of the possible outcomes for patients recovering from coma. The conventional clinical assessment for consciousness is inherently difficult and leads to a high rate of misdiagnosis. In recent years neuroscientific methods have been successfully applied to investigate residual cognitive functions in patients in the complete absence of motor behaviour. Other studies have demonstrated that meaningful (emotional) stimuli can induce more widespread neuronal responses in such patients. In particular, the processing of angry prosody is well known to attract attention regardless of conscious or voluntary engagement. Together these findings suggest that emotional stimuli might be better suited to test patients with disorders of consciousness. **Methods** - We recorded 32-channels EEG in a sample of 13 healthy wake volunteers as well as 21 sleeping subjects. The paradigm consisted of an active and a passive condition in which subjects were asked to respectively count or rather just listen to the own name (SON) or matched unfamiliar names. Stimuli were either spoken by an angry or a neutral voice. We calculated event related synchronization (ERS) in the theta band (4-7Hz) as well as event-related potentials (P3: 250-350ms, LPP: 400-800ms). **Results** - In the active condition results revealed stronger theta-ERS (33% synchronization compared to the baseline; SD=12) for target compared to non-targets over central recordings sites (200-400ms post-stimulus). In the passive condition we surprisingly found greater theta-ERS for neutral voices compared to angry voices over fronto-central sites (FC3=32%, SD=8%; FC4=36%, SD=11%). First ERP results reveal a stronger P3 and LPP during waking for angry as compared to neutral voices as well as a more pronounced LPP in N1-sleep. In N2-sleep a P3-difference on the other hand indicated a stronger response for SON as compared to other-names.

Conclusion - The presence of a greater theta-ERS for target than for non-targets might in general reflect a higher level of cognitive processing and importantly the ability to voluntarily orient attention. ERP results during sleep on other hand indicate preserved processing of saliency to a certain degree. Altogether, we therefore believe that EEG can contribute to further refine diagnosis and better understand residual capabilities of unresponsive patients in the near future.

Kindly supported by the Austrian Science Fund FWF (Y-777; W1233-G17).

P098 - Conscious processing of emotional faces in the brain under the crowding task: event-related potential (ERP) study

Remigiusz Szczepanowski [1], Piotr Stykowiec [2], Eligiusz Wronka [3], Michał Folwarczny [1]

[1] University of Social Science and Humanities, Faculty in Wrocław, Poland, [2] Faculty of Psychology, University of Wrocław, Poland, [3] Psychophysiology Lab, Institute of Psychology, Jagiellonian University, Krakow, Poland.

It is well established that stimuli viewed out of central vision, and located in a periphery tend to be recognized with diminished accuracy. Moreover, visual crowding studies show that similar nearby features of crowded objects impair awareness in peripheral vision. According to top-down accounts crowded information is not missed but rather attentionally non-accessed, therefore crowded information can reach several stages of visual processing effectively influencing our behavior in an unconscious fashion. For example, long-lasting crowded emotion information such as facial expressions can effectively prime subsequent judgments on neutral targets. Here, we examined how the encoding of

crowded emotion information affected visual processing at higher levels by investigating conscious awareness of crowded emotion information and its psychophysiological correlates based on event-related potentials (ERP). In the peripheral vision condition, we presented participants with either an angry expression or scrambled face with no expression surrounded by the six neutral flankers, and then probed their visual awareness with a confidence ratings scale. We analyzed electrophysiological components of emotion visual processing with Early Posterior Negativity (EPN) and N170 waves. An EEG analysis showed more pronounced EPN amplitudes for aware responses regardless of a crowded object perceived. It also turned out that the face-sensitive N170 component in the right hemisphere was elevated, but only when the angry expression was displayed. Our ERP findings suggest that conscious awareness of emotional crowded depends on the effectiveness of early visual information processing, regardless of the emotional valence of the crowded stimuli. The present study provides also support that early visual ERP components can be used to index conscious processing of crowded information. ACKNOWLEDGMENTS. Supported by the National Science Center (Poland), and funded under the grant's decision DEC-2011/03/B/HS6/01799 to R.S.

LEARNING & MEMORY

P099 - Change of irrelevant features in tasks as the condition of appearance of regular errors

Natalia Andriyanova [1]

[1] Saint-Petersburg State University, Russia.

The current study investigated the ways of prevention and correction of regular errors in the learning process. There are a lot of evidences on regularities of appearance and repetition of errors in the learning process. However such regularities are usually registered after completion of learning process and errors tend to consolidate. We assume to assess the influence of irrelevant features in tasks to the appearance of regular errors. It's important to determine the confines of the negative choice aftereffect and to find the conditions which can reduce it. Furthermore investigation of the mechanism of errors correction plays great role in the understanding of learning process. Originality of this research consists in the search of methods which correct regular errors and don't allow their strengthening. We assume that change of irrelevant features in stimuli exchanges the situation and the task for person, while the task and the relevant features in stimuli are the same. Therefore we suppose that change of irrelevant features in tasks results in reduction of regular errors. There are two experiments in our research aimed at identifying different but resembling stimuli. We compare the groups with and without change of irrelevant features of the experimental task. We use color variation of stimuli as irrelevant features. Also we use different types of irrelevant features' change (regular and chaotic). It was shown in our both experiments that there were less repeated errors in the group with regular change of irrelevant features than in groups with chaotic changes and without any changes. Thus, changes of irrelevant features in tasks led to activation of conscious control, causing reduction of regular errors.

P100 - Visual recovery in cortical blindness

Antoine Barbot [1,2], Matthew Cavanaugh [1,2], Eli Merriam [3], Anasuya Das [1,2], David Heeger [3], Krystel Huxlin [1,2,4] and Michael Melnick [4]

[1] Flaum Eye Institute University of Rochester Medical Center NY USA, [2] Center for Visual Science, University of Rochester Medical Center NY USA, [3] Center for Neural Science New York University NY USA [4] Department of Brain and Cognitive Sciences University of Rochester NY USA.

Background: Damage to the adult primary visual cortex (V1) causes a loss of conscious vision over the same part of the visual field in both eyes (cortical blindness—CB). This increasingly common cause of permanent disability in adult humans is still considered untreatable. However, using a perceptual rehabilitation program, we showed that perceptual training can lead to visual recovery in CB subjects (Huxlin et al., 2009; Das et al., 2014). Here, we asked how visual training affects both visual perception and visually-evoked fMRI activity. Methods: Eight CB subjects were trained for several weeks to

discriminate orientation and/or global motion direction with stimuli presented inside the first 5 degrees of their blind field borders. Visual field mapping using luminance detection (Humphrey) perimetry with controlled fixation and retinotopic fMRI activity were measured before training and following recovery. Results: Visual training significantly improved discrimination performance and luminance detection at trained blind field locations, as well as at untrained locations along the blind field border. Control [untrained] CB subjects (n=6) did not show any significant improvements in Humphrey perimetry. Standard fMRI retinotopic mapping revealed two types of post-lesion retinotopic organization before training onset. All CB subjects exhibited normal retinotopic organization in their intact hemispheres and in dorsal visual areas (V2d, V3d, V3A/B, hMT+) of their damaged hemispheres. However, preserved ventral visual organization (V2v, V3v, V4) of the damaged hemispheres was observed only when the subjects' central region (2-4 deg) of the upper field quadrant was preserved. This organizational pattern occurred regardless of lesion size/duration or defects in lower visual field quadrants. Preliminary post-training fMRI analysis showed no changes in retinotopic organization in the intact or damaged hemispheres. Ongoing work will assess whether more subtle changes in visually-evoked fMRI activity occur specifically within regions of cortex representing recovered regions of the visual field. Conclusion: Our findings show that visual recovery in CB is not accompanied by gross changes in overall retinotopic organization in intact or damaged brain hemispheres...

P101 - Do presentation rate and incidental vs. intentional learning conditions impact on visual statistical learning? Influences on the acquired knowledge and its availability to consciousness

Julie Bertels [1,2], Arnaud Destrebecqz [1], Ana Franco [1]

[1] Université Libre de Bruxelles, [2] Fonds de la Recherche Scientifique – FNRS.

Arciuli et al. (2014) recently argued that prior knowledge of the existence of statistical regularities in a sequence of shapes would increase learning of these regularities exclusively in situations allowing the involvement of strategies, namely with long presentation rates. The aim of the present study was (1) to test this assumption directly by investigating how learning condition (incidental vs. intentional) and presentation rate (fast vs. moderate) affect participants' knowledge of the regularities and (2) to examine how these factors influence the conscious vs. unconscious nature of the acquired knowledge. We exposed participants to four triplets (i.e. groups of three shapes presented sequentially) and assessed their degree of learning in a subsequent completion task integrating confidence judgments. Replicating previous results (Bertels et al., 2012), we observed that participants acquired both implicit and explicit knowledge of the triplets, even under incidental learning conditions and at fast presentation rates. Supporting Arciuli et al.'s claim, participants' performance benefited from intentional learning only at moderate presentation rates. Moreover, informing participants about the presence of regularities in the stream beforehand increased their explicit knowledge of the sequences, an effect that was not modulated by presentation speed. These results thus support that although visual statistical learning can take place incidentally and, at least to some extent, outside conscious awareness, factors such as moderate presentation speed and prior knowledge of the presence of statistical regularities in the stream can boost learning of these regularities, presumably by favoring the acquisition of explicit knowledge.

P102 - Implicit learning of statistical regularities: it's not all automatic

Maximilien Chaumon [1,2,*], Sabrina Trapp [3,*], Niko A. Busch [2], Moshe Bar [4]

[1] Berlin School of Mind and Brain, Humboldt-Universität zu Berlin, Berlin, Germany [2] Institut für Medizinische Psychologie, Charité Universitätsmedizin, Berlin, Germany [3] Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany [4] Gonda Multidisciplinary Brain Research Center, Bar-Ilan University, Ramat Gan, Israel, [*] These authors contributed equally to this work.

Learning statistical regularities from the environment to form predictions about upcoming sensory events seems an effortless task that we perform without even noticing it. However, the exact relationship between various correlates of consciousness and statistical learning is an active research topic. For example, whether learning environmental regularities requires engaging working memory onto the to-

be-learned regularities remains a matter of debate. Here, we tested whether registering simple visual statistical regularities in the environment to predict upcoming stimuli requires working memory resources. We presented human subjects with a simple object categorization task during the retention period of a working memory task vs. during performance of a control task not requiring working memory resources. Unbeknownst to the subjects, hidden regularities could allow predicting some features of the upcoming objects in the categorization task. Using these predictions could allow speeding up reaction times in the categorization task. We presented several types of regularities: identity regularities, where the identity of certain presented objects predicted the identity of the following ones, spatial regularities, where the spatial location of a presented object on the screen predicted the location of the upcoming one, and combinations of these two types of regularities and predictions. We also manipulated the type of working memory (verbal or visuo-spatial) engaged during the task. In line with previous research, we found that statistical regularities could be used by subjects without awareness when working memory was not engaged (control task). Subjects were reliably faster in the categorization task when the currently presented object could be predicted by the previous one. By contrast, loading working memory with visuo-spatial or verbal information impaired this facilitation. Specifically, we found that loading working memory impaired forming identity predictions when no uncertainty about the spatial location of the upcoming objects existed. On the other hand, loading working memory had no effect on using spatial regularities to predict upcoming objects. Several control tasks will be discussed where we manipulate cognitive load without working memory.

P103 - The Perruchet effect: Dissociating motor behaviour from conscious expectancy

Arnaud Destrebecqz [1], Julie Bertels [1], Estibaliz San Anton Moracho [1], Michael Vandeveld [1], Axel Cleeremans [1]

[1] Consciousness, Cognition & Computation Group, Center for Research on Cognition & Neurosciences, Université Libre de Bruxelles.

The well-known Perruchet effect is unique in that it provides a strong demonstration that what I think will happen may be completely dissociated from the way I react to what actually happens. Interpretations of this effect have opposed tenants of associative learning theories and tenants of propositional theories of learning. According to associationist, strength theories, learning occurs by automatic reinforcement between co-occurring events in the environment. According to cognitive, or propositional accounts, however, learning depends on conscious hypothesis testing in such a way that performance to an event will improve when participants' conscious expectancies for that event increase. Here, we used a simple reaction time task in which a warning tone was followed by a visual target in 50% of the trials. RT to the visual targets were recorded as well as participants' expectancies before each trial. Results indicated that while expectancy ratings decreased with the number of preceding tone-target trials (a phenomenon known as the gambler's fallacy), RTs became faster with runs of tone-target trials and slower with runs of target-alone trials, providing evidence for associationist accounts of unaware learning. In follow-up experiments, we show that these results do not reflect simple motor priming as suggested by tenants of the propositional accounts. When the tone and the target are disconnected, there is a significant cost in RTs, indicating that associative strength is a reliable component of performance. Expectancies, however, also influenced behavior, as participants who did not show the gambler's fallacy are more influenced by strength than participants who showed the gambler fallacy. Performance in this associative learning task thus results from the interaction of motor priming, associative strength and conscious expectancy.

P104 - Prenatal auditory stimulation and its neurophysiological correlates in newborns

Renata del Giudice [1,2], Christine Blume [1,2], Julia Lechinger [1,2], Andreas Kovacs [1], Julia M. Pletzer [1], Sindy Siebert [1], Claudine Calvet [3], Manuel Schabus [1,2]

[1] Laboratory for Sleep, Cognition and Consciousness Research, Department of Psychology, University of Salzburg, Salzburg, Austria, [2] Centre for Cognitive Neuroscience Salzburg (CCNS), University of Salzburg, Salzburg, Austria, [3] Developmental Psychology, Universität der Künste, Berlin, Germany.

Several studies using various paradigms indicate that learning begins far before birth. This idea raises a whole series of questions about how and what exactly an unborn baby can learn. Research on prenatal learning offers a preferential way to assess early manifestation of human memory and learning as well as more general domains of development and (un)conscious cognitive processing in infants. However, the majority of literature in perinatal learning and infant research relies on single case reports and lacks coherent neurophysiological evidence. Examining the auditory domain provides us with the unique opportunity to examine the neural bases of prenatal learning in the absence of behaviour and voluntary attention. Furthermore, investigating oscillatory brain responses may reveal additional neurophysiological information in the infant-EEG that is usually characterized by a predominance of slow frequencies. In our study ten pregnant women were asked to replay twice a day (from 34 weeks of gestational age onwards), at 80 dB, a nursery rhyme that was previously recorded with their own voice. At around week one and four after birth, newborns were presented with the same rhyme (familiar rhyme, FR) uttered either by the mother's voice (MV) or a stranger's voice (SV) as well as a completely new rhyme (unfamiliar rhyme, UR), in MV and SV. Each stimulus type was presented for a total of five minutes and stimulation sequence was randomized during the session. During the experimental session, video as well as high density EEG, (mouth) EMG, and ECG were recorded. Preliminary results indicate that the amount of task-related de/synchronization (TRD/TRS) in low frequency bands (4 – 8 Hz) after 400 ms allows differentiating between familiar and unfamiliar stimuli suggesting a possible involvement of these frequencies in memory and emotional processing. ECG results appear consistent between conditions within-subject, but vary tremendously between newborns. Furthermore, we intend to present subtle signs of behaviour -related to (non)emotional stimuli- as derived from simultaneously videography recordings.

Funds: FWF Y-777, W1233

P105 - Investigation of the frequency tagged responses as an index of incidental statistical learning

Farthouat Juliane [1], Op de Beeck Marc [2], Mary Alison [1], Delpouve Julie [1,2], Leproult Rachel [1], Franco Ana [3], Wens Vincent [2], De Tiège Xavier [2] & Peigneux Philippe [2]

[1] UR2NF, Neuropsychology and Functional Neuroimaging Research Unit at CRCN, Centre de Recherches en Cognition et Neurosciences and UNI - ULB Neurosciences Institute at the Université Libre de Bruxelles (ULB) [2] LCFC, Laboratoire de Cartographie fonctionnelle du Cerveau, UNI – ULB Neurosciences Institute, Université libre de Bruxelles (ULB) [3] UNESCOG, Unité de Recherche en Neurosciences Cognitives at CRCN, Centre de Recherches en Cognition et Neurosciences and UNI - ULB Neurosciences Institute at the Université Libre de Bruxelles (ULB).

Statistical learning (SL) is the incidental and automatic learning of transitional probabilities embedded in a continuous stream of stimuli, progressively segmented into recurrent subparts. In the present MEG study, we hypothesized that changes in neural oscillations synchronized with stimulus presentation might represent a robust alternative to standard behavioral tests to assess online SL. Indeed, cerebral electromagnetic activity can respond to stimulation by resonating at the frequency of stimulation. We predicted that during the audition of tritones embedded in a constant flow, the resonance frequency initially reflecting tones succession will gradually shift to a resonance at the level of the triplets, hence reflecting effective segmentation. Twelve pure sounds were assigned to either a statistical stream, in which tones were always grouped as tritones, or to a random stream in which tones were randomly presented. Participants were asked to listen passively to both streams for 20 minutes, and random and statistical streams were inter-mixed to make the learning more incident. Spectral analyses of both statistical and random streams were performed using wavelet transform and analyses were focused on both frequencies of interest: the tritone (1.8 Hz) and the tone frequencies (5.5 Hz). In line with our

predictions, we found increased tritone frequency power and decreased tone frequency power, during the statistical as compared to the random streams. Importantly, the increase in tritone frequency power, as compared to neighboring frequency bins, was only present during statistical streams. This increase took place progressively over the first minutes of stimulation, reaching significance after 3 minutes of exposure. The shift of frequency power was particularly important on bilateral temporal sensors, localized by source reconstruction in the right primary and secondary auditory cortices. Finally, the decrease and/or increase of frequency power was found robust in all participants (N=12). These results suggest that as the segmentation process occurs, participants process the auditory stream less as a repetition of tones but more as a repetition of tritones. Increased/decreased power in frequency-tagged responses also proves a good individual neural marker of statistical learning and a robust method to assess SL.

P106 - Implicit sequence learning of surface and abstract structures

Qiufang Fu [1], Huiming Sun [1], Dienes Zoltan [2], Xiaoan Fu [1]

[1]State Key Laboratory of Brain and Cognitive Science, Institute of Psychology, Chinese Academy of Sciences, Beijing, 100101, China, [2] Sackler Centre for Consciousness Science and School of Psychology, University of Sussex, BN1 9QH, Brighton, United Kingdom.

It remains controversial whether people acquire knowledge about specific exemplars or abstract structure in implicit learning and also whether the degree of abstraction determines the conscious status of the knowledge. Most recent studies in implicit learning have adopted second-order conditional (SOC) sequences in a serial reaction time (SRT) task to investigate how people acquire chunks. Thus, researchers have tended to ignore the question of whether people can acquire structure more abstract than memorized chunks in implicit sequence learning. However, the degree of abstraction that can be implicitly learnt has important consequence for computational models and theories of implicit learning. Therefore, the present study adopted SOC sequences with same and different abstract structures in a SRT task. The stimuli were four types of color squares and participants responded to each of them by pressing a corresponding key. Unbeknownst to participants, there were three types of stimuli that differed in the sequence. Standard and transfer stimuli followed the SOC sequences but differed in the probability of presentation: one with a high probability (.83), one with a low probability (.083). Deviant stimuli were also presented with a low probability (.083) but followed neither SOC sequence. Thus, standard and transfer differed in terms of specific chunks, while transfer and deviant differed in abstract structures. After the training, participants were asked to complete an inclusion test and an exclusion test. We also manipulated the amount of training to explore how it influenced the learning effect of chunks and abstract structures. The RT results showed that participants responded more quickly to standard than to transfer and more quickly to transfer than to deviant in both the short and long training conditions, indicating that people acquired both chunking and abstract structures of the temporal sequence. The generation performance revealed that people generated more standard and transfer sequences under inclusion than exclusion but less deviant sequences under inclusion than exclusion regardless of the training, suggesting that they could not control the expression of the chunk structure but could control the expression of the abstract structure. That is, they acquired unconscious knowledge about chunk structure but conscious knowledge about the abstract structure of the temporal sequence.

P107 - Working Memory is not a Natural Kind

Javier Gomez-Lavin [1]

[1] CUNY Graduate Center.

Working memory (WM) describes the cognitive capacity to store, maintain, and manipulate a limited amount of information for short durations. WM has been a central focus of research in cognitive psychology for over 40 years. Currently, many psychologists and philosophers incorporate WM as a cornerstone in their theories of consciousness, e.g. Baars' global workspace theory and Prinz's attended intermediate representations theory. In this paper I argue that that WM is neither a natural kind, nor a *prima facie* desirable construct for either neuroscientific research or philosophical study. I argue that, instead, our contemporary understanding of WM as a robust, unified system, and its

constitutive relation to consciousness, has developed largely as an artifact of WM task demands. That is, what unifies disparate neural regions and dissociable functions such as the manipulation of motor plans, auditory rehearsal, and conscious reporting is not their membership in a kind, but their participation in largely similar tasks, namely goal-directed short-term memory tasks. Importantly, I do not claim that we are unable to store or manipulate limited amounts of information. Rather, I employ results from recent neuroimaging studies to motivate the claim that these capacities are a result of the dissociable recruitment of many far more basal systems with adaptive populations of neurons engaged in premotor planning, object and spatial attention, and so on, in conjunction with a plethora of continuous mnemonic sensory capacities (e.g., iconic, fragile, and conceptual short term memories). Eschewing WM in favor of a more distributed approach, wherein subpersonal basal systems collectively and differentially interact to produce person-level cognitive phenomena—such as keeping a phone number in mind—will give us purchase on important philosophical questions, for example, the nature and format of these systems' representations. Lastly, I review the consequences of this account for the two previously mentioned theories of consciousness, arguing that they risk circularity unless they can adequately dissociate consciousness or conscious report from the mnemonic and executive processes recruited in prototypical WM tasks.

P108 - The relation between preferences and implicit knowledge in perceptual categorization task

Anatoliy Karpov [1], Nadezhda V. Moroshkina [1]

[1] General Psychology Division, Department of Psychology, Saint Petersburg State University, Russia.

Different studies show that implicit knowledge can influence the preferences of the person. For instance, subjects evaluate grammatical strings as more pleasant as compared to nongrammatical ones in artificial grammar learning experiments (Forkstam et al., 2008; Newell, Bright, 2000). Subjects also tend to prefer stimuli with predictive value in visual search tasks where configuration of distractor items allows predicting a target location (Ogawa, Watanabe, 2011). A possible explanation is suggested that implicit learning provokes fluency in the processing of stimuli. As a result of effortless processing the stimuli are perceived as more pleasant. However, controversial question is what exactly affects subjects' preferences in implicit learning tasks. It might be the presence of implicit knowledge about the stimuli as well as the direct application of this knowledge. To find out which of these two factors might influence subjects' preferences we modified Lewicki paradigm of Hidden Co-variation Detection (Lewicki, 1986). During the learning phase subjects were presented with photos of twenty females together with the IQ scores. Hidden covariation between IQ and haircut of the females (long or short hair) was supposed to be implicitly learned by subjects. Then all the subjects were divided into two groups. The first group immediately evaluated the trust to the new sixteen photos of females with different types of hairstyles. But the second group first estimated IQ of the females within the same set of photos, as presented to the first group, and only after that evaluated the trust to the females on the photos. The main results indicate that the subjects in the second group implicitly learned the covariance between the type of haircut and IQ at the learning phase and applied that knowledge for evaluating IQ of females to the new set of photos. Furthermore, the subjects in the second group evaluated the females within the new set of photos as more trustworthy in comparison with the preferences of the first group. Since we were able to detect implicit learning in the second group, we assume that implicit knowledge was formed in both groups, as the learning stage was the same for all the subjects. But only the second group had to apply the implicit knowledge evaluating IQ of females within the new set of photos. Thus, it is the application of implicit knowledge and not just its presence that has the most significant impact on the preferences of the subjects.

P109 - Implicit learning in perceptual categorization task: dissociation between verbal and imaginative representations

Irina Ovchinnikova [1], Nadezda V. Moroshkina [1]

[1] St.Petersburg State University, Department of Psychology, Russia.

Based on the theories of dual coding (Paivio, 1986 etc.), we have assumed that in the process of learning the subjects formed two types of representations - verbal and imaginative. As experience increases, the level of coherence between those two types of representations leads eventually to the explicit understanding of rule. Consequently, in the case of implicit learning, we must find a lower coherence between verbal and drawing tests of knowledge, as compared to the group with explicit learning (Exp.1), and the higher coherence as compared with the group without learning (Exp.2). There were 2 experiments, participants were asked to categorize objects (the rule was not known), and feedback was given. They were presented geometric shapes, which varied several parameters, served as the basis for categorizing the conjunction of two features: the concavity and vertical symmetry. In the Exp.1, the subjects were divided into consciously and do not realize the categorization rule (verbal test). Both groups of subjects have shown the effectiveness above chance, but the use of drawing tests revealed a number of differences between these groups at the level of figurative representations. The Exp.2 was similar to the first, but ISI was reduced to the subjects rely heavily on intuition. Also we varied the value of feedback: one group of subjects was given congruent feedback; the other group was given incongruent feedback, according to the learning curve of the first group (i.e., feedback was not dependent on the correctness of the answers and only formed an illusion of learning). This was done to compare the quality of figurative representations in the group with implicit learning and group with illusion that they have learned something). The results have shown that both groups estimated their efficiency higher than chance although only the first group learned implicitly. Verbal test revealed no differences between the two groups (all of subjects figured out false signs), but drawing tests of knowledge showed that the degree of coherence of drawings and verbal hypotheses in the group with implicit learning still higher than in the group without learning, which confirms our initial hypothesis.

The authors acknowledge Saint-Petersburg State University for a research grant 8.38.287.2014.

P110 - Probabilistic trend detection in different levels of consciousness

Marta Suárez-Pinilla, Santiago Muñoz-Moldes, Tristán Bekinschtein [1]

[1] University of Cambridge - Department of Psychology

Spontaneous alpha oscillations are traditionally considered to impair visual perception: high alpha power before stimulus presentation is correlated with failures in subsequent visual detection (e.g. Ergenoglu et al., 2004). Despite this evidence, some published studies (e.g. Hanslmayr et al., 2007) as well as recent experiments in our lab failed to observe this effect, suggesting that the mechanisms behind it may be more elusive than previously thought. This study aimed to compare different experimental paradigms to investigate what perceptual mechanism is affected by alpha oscillations. We recorded ongoing brain activity with electroencephalography (EEG) while human observers had to detect either the presence (yes/no) or the spatial location (left/right) of a briefly-presented Gabor patch, or to discriminate between two stimulus orientations (left/right). For each observer and task, we identified the contrast value leading to a visibility threshold of 50% for the yes/no detection and of 75% for the left/right detection and discrimination tasks. The results suggest that strong prestimulus occipital alpha oscillations impair performance only in yes/no detection task, but not in the localisation nor in the orientation discrimination task. These results can be reconciled with previous interpretations of alpha oscillations; namely, weak alpha oscillations are related to a state of increased cortical excitability, which in turn may prime the observer to report stimulus presence. Follow-up studies will investigate the specific effect of prestimulus alpha oscillations on sensory processing and decision-making.

MEASURES OF CONSCIOUSNESS - II

P111 - A pre-registered magnetoencephalography study into the relationship between segmentation of auditory information and cortical oscillations

Christopher Allen [1]

[1] CUBRIC, Cardiff University Brain Research Imaging Centre, Cardiff University, Park Place, Cardiff, UK.

Phenomenology suggests that consciousness is often divided into individuated acts of consciousness or thoughts (Husserl, 1964; Varela, 1996). Evidence has emerged to suggest that the brain's dominant low frequency oscillations impose limitations on information processing and may act to segment and individuate precepts (e.g. Busch, et al, 2009; van Dijk, et al, 2008). However this evidence has almost exclusively been based on observations of visual processing. The lack of evidence across modalities limits the extent to which brain occupations can be accepted as the mechanism by which content is individuated (VanRullen, et al, 2014). Here I develop an auditory task which tracks participants' capacity to segment information according to the rate at which stimuli are presented and asks if there is a relationship between this and oscillatory cortical responses, as measured with magnetoencephalography. Oscillatory amplitude and phase relationships of responses localised to the auditory cortex will be related to stimuli and response conditions in 3 pre-specified ways. First, a series of correlations will test the match between task performance and oscillatory responses over a range of frequencies. Second the effect the stimuli have upon cortical responses will be investigated. The final analyses test the extent to which cortical responses, over a range of measures (oscillatory amplitude, phase consistency and phase angle) are predictive of behavioural success. This is a pre-registered study the details of which can be found at : <https://osf.io/h3z5n/> . Data collection commenced on 27th Feb 2015. Any presentation will consist of a description of the theory and methods of this experiment as well as results, as available at the time of ASSC 19.

Busch, et al, (2009). The phase of ongoing EEG oscillations predicts visual perception. *J Neurosci*, 29(24), 7869–7876.

Husserl, E., Churchill, J. S., & Heidegger, M. (1964). *The Phenomenology of Internal Time Consciousness*. Edited by Martin Heidegger. Trans James S. Churchill.

Van Dijk, et al, (2008). Prestimulus oscillatory activity in the alpha band predicts visual discrimination ability. *J Neurosci*, 28(8), 1816–1823.

VanRullen, et al, (2014). On the cyclic nature of perception in vision versus audition. *Philos Trans R Soc Lond B Biol Sci*, 369(1641), 20130214.

Varela (1996). *The Specious Present: A Neurophenomenology of Time Consciousness*. In Petitot et al, (Ed.), *Naturalizing Phenomenology* (pp. 266–329).

P112 - Connectome Harmonic Signatures of (Un)conscious Neurodynamics

Selen Atasoy [1], Isaac Donnelly [1,2], Joel Pearson [1]

[1] School of Psychology, University of New South Wales, [2] School of Mathematics and Statistics, University of New South Wales.

A fundamental characteristic of human brain activity is spontaneous coherent oscillations among spatially distributed cortical areas. Remarkably, the topography of these correlation patterns, termed resting state networks (RSNs), closely resembles the functional networks identified by various sensory, motor, and cognitive paradigms. Although this overlap indicates RSNs' relevance for active cognitive processes and conscious awareness, coherent fluctuations are found to transcend levels of consciousness, observed in light sleep, anaesthetised adults and non-human primates, and a comatose patient. Recent evidence revealed that while correlated activity is preserved during loss of consciousness (LoC) in deep sleep, substantial changes occur in the anatomical configuration of the RSNs. However, mechanisms underlying the emergence of the RSNs from the primate connectome and their relationship to neurophysiology remain unknown. Here we introduce a new technique, an extension of the Fourier transform to the human connectome, to show that the functional networks of the human brain are governed by a near universal harmonic language...

P113 - Improving the measures of awareness. A proposal of two novel methods

Justyna Hobot [1], Anna Anzulewicz [1], Borysław Paulewicz [2], Michał Wierzchoń [1]

[1] Consciousness Lab, Institute of Psychology, Jagiellonian University, Krakow, Poland, [2], Warsaw School of Social Science and Humanities, Faculty in Katowice, Poland.

Various measures have been proposed for assessing the extent of stimulus awareness, but none of them is optimal. We argue in favor of the idea that continuous scales of consciousness may serve as sensitive tools for measuring visual awareness, if their disadvantages are properly addressed. Here we present the results of two experiments that introduce two novel scales. The first scale, named Continuous Perceptual Awareness Scale (C-PAS) combines the advantages of Perceptual Awareness Scale (PAS) and Continuous Visual Scale (CVS) by including four response categories inside the continuous scale, labeled in the same manner as in the PAS. The second of the proposed scales, Awareness Intensity Scale (AIS) depends on the color intensity perception and is intended to eliminate the verbalization issue. Both scales should allow for more precise and sensitive measurement of visual awareness than the scales which are currently used. Their capacity to measure the degree of association between accuracy and perceptual awareness was verified in the experiments employing a discrimination task, in which the proposed scales were compared to the PAS and CVS. The results of the first study indicate that the C-PAS scale predicts awareness to a larger extent than the two other scales. The data from the second experiment, which aims to validate the utility of the AIS, are currently undergoing analysis. In this poster we put forward innovative solutions for continuous scale designs and discuss whether they enable us to capture the subjective experience diversity to a greater extent.

P114 - Methodological pitfalls of clinical validation studies in the science of consciousness

Andrew Peterson [1,2], Charles Weijer [1,2,3], Adrian M. Owen [1,2]

[1] Rotman Institute of Philosophy, Western University, [2] The Brain and Mind Institute, Western University, [3] Department of Epidemiology and Biostatistics, Western University.

How do we conduct a clinical validation study on neuroimaging techniques used to assess covert awareness in severely brain-injured patients? One answer is to apply a study design used in other domains of medicine. This may involve assessing the clinical utility of two or more neuroimaging techniques against a gold standard. Stender and colleagues' recent study comparing 18F-FDG-PET and fMRI mental imagery against the Coma Recovery Scale is an example of this approach (Stender et al., 2014; Lancet). 18F-FDG-PET measures cortical metabolism in certain awareness supporting brain networks (Laureys, Owen, and Schiff, 2005; Lancet), while fMRI mental imagery infers awareness from a patient's volitional brain activity (Owen et al., 2006; Science). Comparison with the Coma Recovery Scale should, according to Stender and colleagues, determine clinical utility. But this assumption may be questioned for two reasons (Owen, 2014; Nature Reviews Neurology). First, it is not clear that awareness can be inferred from 18F-FDG PET in the same fashion as fMRI mental imagery. While evidence of cortical metabolism in certain brain networks may be necessary for awareness, it is currently insufficient for the attribution of awareness in differential diagnosis. This suggests there may be important differences to 18F-FDG PET and fMRI mental imagery designs that render any comparison logically spurious. Second, it is unclear whether the Coma Recovery Scale is an appropriate independent measure for comparison. Several studies have demonstrated that both fMRI mental imagery and 18F-FDG PET can detect evidence of awareness in patients whose performance on the Coma Recovery Scale is consistent with the vegetative state. This suggests that the Coma Recovery Scale may not suffice as a gold standard. These worries bring to light unique methodological pitfalls in the conduct of clinical validation studies in this research domain. We aim to sharpen these methodological pitfalls by raising two questions: 1) Are certain neuroimaging techniques more appropriate to compare than others and why? 2) Is there any measure of awareness that suffices as a gold standard and what would it look like? We argue that reflection on these questions may benefit investigators conducting future clinical validation studies in the science of consciousness.

P115 - Probing conscious experience of rich, naturalistic stimuli

Leah Sinai [1,2], Chris Fiacconi [1], Laura Gonzalez-Lara [1], Rhodri Cusack [1,2], Adrian Owen [1,2], Lorina Naci [1]

[1] Brain and Mind Institute, Western University, London, ON, Canada, [2] Department of Psychology, Western University, London ON, Canada.

Non-responsive patients with disorders of consciousness (DoC) are unable to speak or exhibit willful behavior. Previous command-following paradigms have shown that brain activity can serve as a proxy for behavior. However, these tasks are difficult for patients and naturalistic paradigms have been proposed as an easier alternative. Naci et al. (2014) introduced a neural index that, in a group of healthy controls, predicted each individual's conscious experience while watching a movie. This approach demonstrated intact conscious experience in a brain-injured patient who had remained behaviorally non-responsive for many years. However, as many DoC patients cannot process visual stimuli, we aimed to develop an auditory-only stimulus to test conscious cognition in this group. In addition the possible use of a cheap and portable technology that would allow testing at the bedside, such as the Galvanic Skin Response (GSR), was explored. GSR measures sweat changes on the fingertips in response to stimuli and, as it reflects brain activity, could give an indication to perception and cognition in DoC patients. We tested the fMRI response to four auditory stimuli in healthy controls (N=15). The inter-subject synchronization and single-subject response to each stimulus was calculated. The GSR to the best auditory narrative and the movie from Naci et al. (2014) was tested in an independent group (N=17). We calculated the inter-subject correlation of the GSR for each stimulus, and the one reliable at the single-subject level was further tested in DoC patients (N=6) by comparing each patient's GSR to that of controls. Of the 4 auditory stimuli tested with fMRI, the narrative 'Taken' elicited the most robust inter-subject synchronization. This auditory narrative did not show significant GSR inter-subject correlation, by contrast to the movie ($r = .72$). Moreover, one DoC (Locked-In Syndrome) patient showed a highly similar GSR to controls when viewing the same movie ($r = .77$). In conclusion, the widespread inter-subject synchronization suggests that 'Taken' can be used for future fMRI patient testing. However, the variable individual GSR to this stimulus does not warrant using it at the bedside. By contrast, the movie showed highly similar GSR in controls. Critically, the highly similar GSR of one behaviorally non-responsive patient to that of healthy controls suggests, for the first time, that GSR can be used to test covert consciousness at the patient's bedside.

P116 - The scale does matter – different scales of consciousness show different results in the same tasks

Zuzanna Skóra [1], Marta Siedlecka [1], Borysław Paulewicz [2], Michał Wierchoń [1]

[1] Consciousness Lab, Institute of Psychology, Jagiellonian University, Krakow, Poland, [2] Warsaw School of Social Science and Humanities, Faculty in Katowice, Poland.

Subjective scales of consciousness are now commonly appreciated as a way of quantifying conscious experience with losing as little of its subjective character as possible. Scales that have gained special interest are: Perceptual Awareness Scale (PAS) and Confidence Rating scale (CR). There has been an ongoing discussion whether these scales measure the same aspects of conscious experience. Here we are reporting two experiments showing that PAS and CR yield different results in backward masking task and Lamme's change blindness paradigm. In the first experiment we used backward masking paradigm with Gabor patches that were presented between 15-64ms. Participants either made the discrimination decision first and then assessed their stimuli awareness on the scale (DS) or first used the scale and then did the discrimination task (SD). The results showed that the relationship between awareness ratings and performance was weaker when the awareness rating happened before the orientation task. Although this effect was replicated several times we did not manage to detect it using Confidence Rating scale in the same task. The second study, which utilised Lamme's change blindness paradigm, was a partial replication of an experiment regarding the metacognition in different types of visual short-term memory. In the original experiment, it was found that the metacognition for iconic memory and visual working memory was at the same level, which was much lower than the metacognition for fragile visual short-term memory. The results, originally obtained through

administering the CR scale, were not replicated with the PAS. It seems important to continue exploring the differences between the subjective scales of consciousness. Many researchers administer them interchangeably for different kinds of tasks. Although the question of what variables influence each scale still remains open, the evidence presented above, suggests that using scales interchangeably seems unjustified and may lead to erroneous conclusions. We discuss possible theoretical explanations of this effect and methodological implications.

P117 - Dissociating Measures of Consciousness from Measures of Short-Term Memory.

Thomas Alrik Sørensen [1,2], Árni Gunnar Ásgeirsson [4,2], Camilla Funch Staugaard [3], & Morten Storm Overgaard [2,1]

[1] Centre for Cognitive Neuroscience, Aalborg University, [2] Cognitive Neuroscience Research Unit, CFIN, MindLab, Aarhus University, [3] Center for Visual Cognition, University of Copenhagen, [4] Cognitive Psychology Unit, Leiden University.

Often, the contents of consciousness are equated with the contents of short-term memory (or working memory), sometimes to a point where they are treated as identical entities. In the present study we aimed to investigate whether they may be modulated independently and thus dissociated from each other. Previously, we have demonstrated that introspective access and conscious content can affect ERP's and behaviour in observers during a visual task (Overgaard, Koivisto, Sørensen, Vangkilde, & Revonsuo, 2006). If introspective access to content can modulate performance, one may question if conscious content simply can be reduced to a cognitive process like short-term memory. In two experiments, we combined two different measures of short-term memory capacity to investigate how manipulations of set-size affect performance in observers with the Perceptual Awareness Scale (PAS) to measure conscious experience of the stimulus in every trial (Ramsøy & Overgaard, 2004; Overgaard & Sørensen, 2004). We trained observers to report their experience of a visual target stimulus on the four-point PAS scale; ranging from "no experience" to "clear experience". To measure short-term memory we used a traditional object based post cue variation of the partial-report paradigm (Sperling, 1960) in experiment 1. Whereas we used the more novel feature based resolution paradigm (Wilken & Ma, 2004) in experiment 2, in which observers had to report the orientation of a cued Landolt C ring. Not surprisingly, we found that increasing task-load through varying set-sizes affected performance in the short-term memory task as well as in the PAS ratings systematically in the both experiments. Interestingly, the two experiments also revealed systematic set-size effect within each of the individual PAS categories. These results indicate that the measure of the experienced content of consciousness does not relate to the measure of short-term memory in a 1:1 fashion.

P118 - Hierarchy of Complexity Embedded in Awake Brain Dynamics

Satohiro Tajima [1,2], Toru Yanagawa [2], Naotaka Fujii [2], and Taro Toyoizumi [2,3]

[1] Department of Neuroscience, University of Geneva, [2] Brain Science Institute, RIKEN, [3] Department of Computational Intelligence and Systems Science, Tokyo Institute of Technology.

Conscious to unconscious brain-state change impacts both local neuronal dynamics and global interactive networks. However, the link among them is unknown. We introduce a new method, based on the embedding theory in nonlinear state-space reconstruction that links dimensionality of local attractor dynamics with directional cross-area interaction. It reveals a novel cortical hierarchy, where the attractor dimensionality increases along cross-area information flow. Interestingly, this hierarchical organization reflects (1) not specific behavioral/sensory contents but level of consciousness, (2) not area-intrinsic timescale/noise but asymmetric sensory-frontoparietal interactions. Importantly, the present method captures structural changes, which can be missed by conventional correlation-based analysis using momentary activity snapshots. It suggests an emergent function of complex temporal pattern, whose dimensionality increases under consciousness. Based on these new dynamical constraints, we model the large-scale brain dynamics, and propose the integrative global interaction increasing dynamical dimensionality as a mechanistic foundation of the rich cognitive/behavioral capacities in conscious organisms.

PERCEPTUAL CONSCIOUSNESS - II

P119 - Perception of numbers as a case of cognitive penetration

Valtteri Arstila [1,2]

[1] Department of Behavioral sciences and Philosophy, University of Turku, 20014, Turku, Finland, [2] Turku Brain and Mind Centre, University of Turku, 20014, Turku, Finland.

The cognitive penetrability of perceptual experiences remains highly debated issue. For example, while it has been suggested that our perceptions of bistable figures sometimes illustrate cognitive penetrability, this idea has also been objected by maintaining that the differences in the perceptual experiences mirror differences in spatial attention. Other possible candidates of cognitive penetration in turn have been refuted based on the claim that in those cases perceptual experiences are not altered by cognitive states. Instead, the only thing that changes is the judgment of the content of perceptual experiences. In short, all suggested candidates of cognitive penetration can also be explained with reference to non-cognitive factors and the issue of cognitive penetrability remains unresolved. My objective is to present a new candidate for a case of cognitive penetration that is based on the studies concerning common mechanisms of magnitude representation. For the case at hand, the most important results of these studies are those in which Arabic numerals (that is, conventional symbols) of large numbers are perceived to last longer and be physically larger than Arabic numerals of small numbers. Given that these results are unlikely to be due to attentional effects, and that there are reasons to regard the effects perceptual, the candidate is immune to the mentioned alternative interpretations that rely on non-cognitive factors. Therefore, without further counterarguments, the perception of numbers is likely to be an example of cognitive penetration.

P120 - The reversal of perceptual and motor compatibility effects differs qualitatively between metacontrast and random-line masks

Anne Atas [1,2,3], Estibaliz San Anton [1,2,3], Axel Cleeremans[1,2,3]

[1] Center for Research in Cognition and Neurosciences (CRCN), Université Libre de Bruxelles, Brussels, Belgium, [2] ULB Neuroscience Institute (UNI), Université Libre de Bruxelles, Brussels, Belgium, [3] Consciousness, Cognition and Computation Group (CO3).

In masked priming tasks, participants typically respond faster to compatible than to incompatible primes, an effect that has been dubbed as the positive compatibility effect (PCE). However, when the interval between the prime and the mask is relatively long, responses are faster to incompatible than to compatible primes. This inversion is called the negative compatibility effect (NCE). Two main origins of the NCE have been proposed. The object-updating theory holds that when the masks share stimulus features with the primes, both perceptual and motor processes generate an NCE. As an example, for masks composed of overlaid left and right prime arrows, the NCE is thought to be positive priming induced by the arrow of the mask pointing in the opposite direction of the prime. In contrast, the motor inhibition theories hold that the origin of the NCE is purely motor and can be demonstrated when masks do not share features with primes. To test both hypotheses, the present study aims at delineating the respective contributions of perceptual and motor components of the NCE in the context of different types of masks. Consistent with the object-updating hypothesis, we found both perceptual and motor NCEs at the long SOA with metacontrast masks (with internal contours corresponding to left and right overlaid arrows). Consistent with the motor inhibition hypothesis, we found motor NCE but no perceptual NCE at the long SOA with random-line masks (containing no prime features). The study thus suggests that the origin of the NCE depends on the type of mask.

P121 - Conscious perception is limited by overlap in neural channels

Michael A. Cohen [1]

[1] McGovern Institute for Brain Research, Department of Brain and Cognitive Sciences, Massachusetts Institute of Technology.

High-level visual categories - faces, bodies, scenes, and objects - are represented by distinct neural mechanisms across the visual cortex. Here, we show that this division of neural resources affects the ability to consciously perceive multiple items. In a change detection task, we found that performance was superior when items came from different categories (e.g., two faces/two scenes) compared to when items came from one category (e.g., four faces). The magnitude of this mixed-category benefit depended on which stimulus categories were paired together (e.g., faces and scenes showed a greater behavioral benefit than objects and scenes). Using fMRI, we showed that the size of the mixed-category benefit was predicted by the amount of separation between neural response patterns, particularly within occipitotemporal cortex. These results suggest that the ability to process multiple items at once is limited by the extent to which those items are represented by separate neural populations.

P122 - Spatiotemporal Tracking of the Neural Representation of Dominant Percepts during Binocular Rivalry

Nadine Dijkstra [1], Marieke van de Nieuwenhuizen [1], Marcel van Gerven [1]

[1] Radboud University Nijmegen, Donders Institute for Brain, Cognition and Behaviour, Nijmegen, the Netherlands.

During binocular rivalry two different images are presented to the two eyes. Instead of perceiving a mixture of the two stimuli, subjects typically only perceive one of the two images at a time. After a few seconds of perceiving one stimulus the other stimulus becomes dominant. Thus, conscious perception alternates while the physical stimulation stays the same (Blake & Logothetis, 2002). Finding neural correlates of the dominant percept during binocular rivalry has been one of the most popular ways to investigate perceptual consciousness. Previous fMRI studies already found representations of the dominant percept both in high-level visual areas (Tong et al., 1998) and in low-level visual areas (Haynes & Rees, 2005). However, it remains unclear how these representations change over time, or where in the visual hierarchy the dominant percept is first represented. We investigated this using multivariate pattern analysis on MEG data. MEG was measured while participants were presented with a face to one eye and a house to another eye. Whenever a switch in percept occurred the participant had to indicate their new percept by means of a button press. Trials were defined as data 2 seconds before until 1 second after the button press. A classifier was trained on this data to decode, at individual time points, which percept was dominant at each trial. Classification accuracy rose above chance level ~900 milliseconds before button press. This means that at this time point the MEG measurements contained enough information to significantly dissociate the two trials. Inspection of the sensors used by the classifier indicates that primary visual cortex provides most information about the dominant percept. Follow-up analyses are expected to provide information about the spatiotemporal dynamics of representation-specific information, allowing the dissociation between bottom-up and top-down drive during binocular rivalry.

P123 - Do you see something in noise? Your personality trait, emotional state and sex affect your tendency to see pareidolia.

Yuichi Kaji [1], Miho Kitamura [2], Norimichi Kitagawa [2]

[1] Tokyo Kasei Gakuin University, [2] NTT Communication Science Laboratories.

We often find a meaningful pattern in a random noise, such as seeing a face or animal in clouds (so-called pareidolia originally introduced by Russian psychiatrist Kandinsky (1885)). We also experience that some individuals can see an object in the clouds but others can find nothing in the clouds, and even among individuals who find something in the clouds, what they see could be different from each other

(e.g., you may see a cat in clouds but another may see a whale). Although a study by Whitson and Galinsky (2008) showed that people who lacked control were more likely to perceive illusory patterns in meaningless noise, how our mental trait and state affects the tendency to see pareidolia and what kind of object to see is largely unknown. The present study explored the effects of personality traits, emotional state, and sex on seeing pareidolia. One hundred sixty-six undergraduates were asked to complete Big Five personality scales (Extroversion, agreeableness, conscientiousness, neuroticism, and openness to experience: Ten-Item Personality Inventory) and mood scales (Positive and Negative Affect Schedule). They were then presented with a random-dot pattern (14.3 x 14.3 cm) printed in a paper. They were asked, if they find something in the noise, to trace the object(s) with a pen. The results show that 77% of the participants reported Pareidolia while 23% did not. An analysis of structural equation modeling revealed that females tend to see pareidolia compared to males, that participants with higher neuroticism tend to see pareidolia, and that participants with lower negative affect tend to see pareidolia in the random-dot pattern. We also found that a various physical characteristics of the drawn images (e.g., area, location, centroid, roundness, etc.) could not predict the participants' personality trait and emotional state. These results suggest that personality trait, emotional state and sex affect the tendency to see pareidolia in noise, but they don't determine what kind of pareidolia to be seen.

P124 - Level of processing influences electrophysiological correlates of perceptual awareness

Marcin Koculak [1], Monika Derda [1], Krzysztof Gociewicz [1], Bert Windey [2], Marek Binder [1], Michał Wierchoń [1]

[1] C-Lab, Institute of Psychology, Jagiellonian University, [2] Ecole Normale Supérieure.

Windey, Gevers, & Cleeremans (2013) claim that the level of stimuli processing (LoP) affects judgment visibility, influencing the transition from unconscious to conscious perception. Following this idea, the main goal of this study was to investigate how LoP manipulation alter the EEG correlates of visual awareness. In particular, we investigated whether LoP will evoke early posterior negativity around 200 ms (visual awareness negativity, VAN) or the late positivity in the P3 window: the patterns of event-related potentials that have been interpreted as electrophysiological correlates of perceptual awareness (e.g. Railo, Koivisto, & Revonsuo, 2011; Salti, Bar-Haim, & Lamy, 2012). To answer this question, we designed two experiments in visual backward masking paradigm. First one was inspired by Salti et al. (2012). At each trial a stimulus (either a line or a letter) was shown randomly in one of four possible locations. Stimuli, displayed for a fixed short duration, were followed by a mask. Participants were asked to perform two tasks assuming different LoP: line slope identification task and letter classification task. After each trial participants rated the stimulus visibility with the PAS scale. Simultaneously, 64-channel EEG data were recorded for further ERP analysis. The second experiment based on Windey et al. (2013) procedure. While EEG recording participants were asked either to identify a color of the digit (a low-level task) or decided whether the presented number is bigger or smaller than 5 (a high-level task). Both tasks were performed on the very same colored number stimuli with fixed duration, followed by the same fixed mask. After each trial PAS ratings were collected. The preliminary results of the study confirm that stimulus visibility, illustrated by the PAS rating, is reflected by differences in ERP responses associated with conscious perception (c.a. 300 ms after stimulus onset). However, level of processing influenced this relation by modulating the shape of the components in which the conscious/unconscious contrast was observed. Detailed analysis of the interplay between ERP responses and LoP will be presented at the meeting.

P125 - Measuring predictive coding signals using frequency-tagging and EEG

Roger Koenig-Robert [1], Noam Gordon [1], Naotsugu Tsuchiya [1], Jeroen J.A. van Boxtel [1] and Jakob Hohwy [1]

[1] Monash University, Melbourne, Australia.

The predictive coding framework proposes a simple neural architecture to explain perception and brain function in general. Two main components of predictive coding are predictions and prediction errors,

corresponding to top-down and bottom-up signals. The brain seeks to minimize the prediction errors by updating and refining its predictions. Crucially, expectations modulate predictions (the stronger the expectations, the greater the prediction signal), while attention modulates the forward feeding of prediction errors. However, there has been little direct experimental support, mainly due to difficulty in simultaneously measuring neural responses associated with predictions and stimulus-induced responses as well as the integration of these two signals, which is associated with prediction errors. Here we present a paradigm in which we use expectation and attention to modulate prediction and prediction error while measuring neural responses associated with these signals. We used electroencephalography (EEG) combined with frequency-tagging using natural images. Semantic wavelet-induced frequency-tagging (SWIFT) [Koenig-Robert and VanRullen 2013, Neuroimage] was used to tag high-level visual areas sensitive to semantics at 1.3Hz. We hypothesised that the SWIFT-tagged responses should travel from high- to lower-visual areas representing the top-down prediction-related signal. Simultaneously, we modulated the luminance of the stimulus at 10Hz to entrain steady-state visual evoked potentials (SSVEP). We hypothesised that the SSVEP-tagged responses should reflect the bottom-up stimulus-induced responses. As an index of the integration of predictions and stimulus-induced responses, we quantified the intermodulatory frequencies (IMF), a phenomenon occurring when a non-linear system integrates different frequencies, which we hypothesize to be associated to the prediction error signal. We found that IMF generated by the interaction of the signals tagged at 1.3 and 10Hz indexed the strength of the prediction error signal, being modulated by the expectation manipulation, as predicted by the predictive coding model. This effect was in turn amplified by attention, as expected from its putative role in boosting forward feeding of prediction errors. Our results are consistent with current accounts of the predictive coding framework.

P126 - The pattern of neural activation under continuous flash suppression in dorsal and ventral stream and its relationship to visual awareness

Karin Ludwig [1,2], Philipp Sterzer [1], Norbert Kathmann [2], Guido Hesselmann [1]

[1] Visual Perception Laboratory, Department of Psychiatry and Psychotherapy, Charité – Universitätsmedizin Berlin, Germany, [2] Department of Psychology, Humboldt-Universität zu Berlin, Germany.

The degree to which stimuli are processed under continuous flash suppression (CFS) remains controversial. In this study using fMRI-BOLD, we sought to compare the neural activation and multivariate decoding accuracies in response to stimuli in higher-order visual areas under different levels of interocular suppression. To this aim, we varied the contrast of the CFS masks in five logarithmic steps and presented face and tool stimuli that were either suppressed by these masks or presented visibly. After a five second presentation, the participants indicated which of the two image categories was presented (guessing if necessary) and subsequently how well they had seen the image using the 4-point perceptual awareness scale (PAS). Behaviourally, visibility – measured both objectively as percent correct on the category naming task and subjectively as the average PAS rating – decreased linearly with increasing contrast (log) of the mask. Neuronally, this pattern was matched in ventral visual areas showing a linear decrease of decoding accuracies with increasing contrast. Decoding accuracies in dorsal areas, however, were better modelled by a step function, showing high accuracies until medium levels of subjective and objective visibility and a drop in accuracies for lower visibility. The results suggest differential relationships between neuronal representation and visual awareness in different parts of the visual system.

P127 - N200 and P300 as reliable markers of conscious visual perception.

Renate Rutiku [1,2], Marit Martin [1], Talis Bachmann [2], Jaan Aru [2,3]

[1] Institute of Psychology, University of Tartu, [2] Institute of Public Law, University of Tartu, [3] Institute of Computer Science, University of Tartu.

Contrasting conditions in which subjects are aware and unaware of particular visual stimuli may not reveal only the neural correlates of consciousness (NCC), but also the prerequisites or consequences of consciousness. We performed two EEG experiments to identify the true NCC by reducing the

probability of possible confounding factors. In the first experiment the role of visual categorical restriction and stimulus predictability were reduced. A heterogeneous stimulus set was presented on threshold contrast and trials with or without conscious perception were compared on balanced subsets of the data. In the second experiment the possible confounding influence of working memory update was manipulated. A masking paradigm with no discrimination task, always the same stimulus and an additional task for the target stimulus was employed. Furthermore, probability of perceiving the target stimulus was constantly kept at a high level of 75%. In both experiments N200 and P300 were identified as the two reliable markers of conscious visual perception. In the first experiment these two markers were common to all perceived stimuli and absent for all non-perceived stimuli. However, considerable variability was observed in their onset latency. In the second experiment N200 and P300 amplitude marked conscious perception of the target stimulus irrespective of the additional working memory task performed by the subjects. Thus, the present results indicate that N200 and P300 are not prerequisites or consequences of consciousness, but reflect the NCC.

P128 - Complex visual integration across the boundary of consciousness

Mark Vergeer [1], Pieter Moors [1], Johan Wagemans [1], Raymond van Ee [1]

[1] Laboratory of Experimental Psychology, University of Leuven, Belgium.

The challenging task of our visual system is to integrate parts of a visual scene into coherent and meaningful wholes or, in other words, to construct integrated representations from the unstructured retinal input. The study of visual integration goes back to Gestalt psychology early in the previous century and has been a prominent research domain since. Its prominent focus has been to unravel the principles responsible for conscious perceptual appearance, for how things look. Hence the commonly used term 'perceptual organization' for the study of how visual integration leads to structured conscious representations. However, by means of visual masking paradigms, and especially since the recent rise of continuous flash suppression as a tool to perceptually suppress visual information in a controlled manner, there has been an increased focus on the extent of visual processing that still occurs unconsciously and how unconscious information processing still influences behavior. By using a binocular rivalry paradigm we provide evidence that seen (i.e., consciously processed) and unseen (i.e., unconsciously processed) stimulus parts can be integrated into complex three-dimensional visual representations. We used two different ambiguous stimuli (the Necker Cube and Structure from Motion) and presented half of a stimulus to one eye and the other half to the opposite eye in such a way that both eyes were competing for awareness. Compared with a control condition in which the halves of the ambiguous figures were actually physically alternating (instead of only perceptually in the rivalry condition), the rivalry condition showed significantly more cases in which the ambiguous figure maintained its perceptual state after an eye switch for both ambiguous figures. For instance, a cylinder perceived to be rotating clockwise maintained its clockwise rotation, also after the other eye and, thus, the other half of the stimulus became dominant. These results indicate that the seen and unseen halves were already integrated into a single complex representation prior to a perceptual (eye) switch occurred. The findings suggest that complex visual integration does not require consciousness, nor has to be completed before awareness emerges, and encourage the use of novel approaches to study the mechanisms and principles which give rise to visual integration, independent of the (un)conscious state of information processing.

P129 - Speed-size illusion explained by wholly empirical theory

Yong Zixin [1], Po-Jang Hsieh [1]

[1] Duke-NUS Graduate Medical School Singapore, Neuroscience and Behavioural Disorders Program.

Large objects are perceived to move slower than smaller ones with the same physical speed. This puzzling perceptual illusion, called the speed-size illusion, is observed in daily life and deemed to be one of the causes of railway crossing collisions. Despite its prevalence in our sensory experiences, no well-grounded explanation has been given. Here, by analyzing videos containing moving objects of various retinal image sizes and speeds, we show that the speed-size effect can be explained by objects'

speed occurrence frequency. We discovered that for any given speed, larger object possess a lower percentile rank in its speed accumulation probability curve, which accounts for its lower perceived speed. This observation implies that the speed-size illusion is a result of past experiences accumulated in the environment, and that the perceptual qualities of conscious experience (i.e. qualia) are empirically evolved according to the frequency of occurrence of the corresponding stimuli.

SELF & BODY - I

P130 - Brain mechanisms of exteroceptive and interoceptive integration in bodily self-consciousness

Fosco Bernasconi*[1,2], **Roberta Ronchi*** [1,2], **Javier Bello-Ruiz** [1,2], **Christian Pfeiffer** [1,2], **Olaf Blanke** [1,2,3]

[1] Laboratory of Cognitive Neuroscience, Brain Mind Institute, School of Life Sciences, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, [2] Center for Neuroprosthetics, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, [3] Neurology Division, Department of Clinical Neurosciences, Geneva University Hospitals, Geneva, Switzerland.
* equal contribution

Bodily self-consciousness (BSC) refers to the conscious experience of the self within the body. Different bodily information (e.g., vision and touch) are integrated to generate BSC: recently, researchers focused their attention on the signals arising from inside the body (interoceptive, e.g. heartbeat), and the integration of exteroceptive and interoceptive signals. Despite the importance of these processes, very limited data are available about how and where interoceptive (e.g., heart) and exteroceptive (e.g., vision) signals for BSC are integrated in the brain. In this study we have investigated the spatiotemporal brain dynamics underpinning cardio-visual integration in 14 healthy subjects. We recorded visual evoked potentials with electroencephalography (EEG) during the perception of a body or a scrambled-body appearing (or not) at the same frequency of participants' heartbeat, and we analysed the brain responses linked to the visual processing. Results showed a global increase in brain response (i.e., global field power) specific for body perception in synchrony with the heart, occurring at about 200ms after the stimulus onset. Further, no modulation in topographies configuration was observed across conditions. Therefore, these results suggest that the cardio-visual integration results in an enhanced brain response of similar intracranial generators. Source estimation revealed enhanced activity within the left parietal lobe. In conclusion, these findings indicate that cardio-visual processing leads to an increased integration of external (i.e., body image) and internal (i.e., own heart beat) bodily features that are BSC relevant.

P132 - Insulated from the moment

Irene de Caso [1] , **Theodoros Karapanagiotidis** [1] , **Zach Cotter** [1] , **Mahiko Konishi** [1] , **Elena Aggius-Vella** [1] , **Daniel S. Margulies** [2] & **Jonathan Smallwood** [1]

[1] Department of Psychology, University of York, York, United Kingdom, [2] Max Planck Research Group: Neuroanatomy & Connectivity, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany.

Operating in tandem, posterior aspects of the cingulate cortex (pCC) and anterior aspects of the medial prefrontal cortex (amPFC) form what is known as the default mode network (DMN). This macro-scale system seems functionally specialised for cognition that is independent from immediate input because of (a) its activation by processes that do not depend on immediate input, such as reflecting on who we are, and (b) its involvement in spontaneous attentional lapses during external task performance. The current study used resting state functional magnetic resonance imaging (rs-fMRI) to explore the psychological correlates of the decoupling of the DMN from systems that serve perception and action. Trait adjectives were presented on the screen outside the scanner. Participants had to make self-reference judgements for some of the adjectives, best friend reference judgements for other adjectives and David Cameron referent judgements for the rest. This was followed by a retrieval phase in which they had to decide whether adjectives on the screen were old or new words. Preliminary results suggest

that individuals who formed strong memory traces when relating items to themselves exhibited greater decoupling between the motor system and the amPFC. In addition, an overall better memory for all item types was associated with reduced connectivity between pCC and lateral occipital cortex. Moreover, participants also performed a stop signal response time task outside the scanner. Lapses in attention during this task were predicted by greater connectivity between the amPFC and the hippocampus. Although the anti-correlation between the DMN and neural systems governing perception and action may explain its tendency to interfere with on-going tasks, its' capacity for sensorimotor and visual decoupling may also help enable the stimulus independent mental contents that this network is hypothesised to support.

P133 - Break on through to the other side: Bottom-up capture of attention despite of a wandering mind

Christoph Huber-Huber [1], Ulrich Ansorge [1]

[1] Department of Basic Psychological Research and Research Methods, University of Vienna, Austria.

Research showed that during mind wandering attention is decoupled from the environment and directed towards internally generated thoughts, suggesting that it could be more difficult to keep attention directed towards stimuli presented in the environment during mind-wandering episodes. So far, this has been shown for the capture of attention by abrupt onsets and for goal-directed forms of attention employed to find a target during visual search. In the present study, we went one step further and investigated whether attentional decoupling would affect bottom-up attentional capture by a colour-singleton distractor. In our task, participants searched for a shape-defined target while response times and errors were measured. An irrelevant colour-singleton distractor was presented on half of the trials. To check for mind-wandering, every few trials participants reported their state of attention on a 9-point Likert scale. We found that reports of mind-wandering are linked to errors and slower responses during visual search. Crucially, however the irrelevant colour-singleton distractor captured attention regardless of the mind-wandering state. The additive effects of mind-wandering and bottom-up attentional capture suggest that some mechanisms of attentional capture by external stimuli are spared during mind-wandering. Results are discussed in light of existing theories of mind-wandering and attentional capture.

P134 - Legal Philosophy of Gender in the Brain

Sara Kimmich [1,2,3]

[1] UCSD Department of Cognitive Science, [2] UCSD Department of Political Science, [3] Veterans Medical Research Center.

The goal of this research review is to take a legal philosophy approach to the discussion of cases brain data involving sex, gender and body modification. In recent years, the field of endogenous neuroendocrinology has made significant progress in understanding how the functional dynamics of the brain and sex hormones may be viewed as the conscious experience of gender. Identifying potential biomarkers for gender identity in the brain has undeniable scientific and social implications, as the neuroscientific investigation for sex and gender may play a major role in the discussion of legal precedent in transgender cases. Introduction to the scientific study of sex and gender identity spectrums and a framework for how brain data should be integrated into current medical models for transgenderism will be discussed.

P135 - Window to the wandering mind - increased pupil diameter indexes the occurrence of self-generated thought

Mahiko Konishi [1], Haakon Engen [2], Donald McLaren [3], Jonathan Smallwood [1]

[1] Department of Psychology - University of York, [2] Department of Social Neuroscience - Max Planck Institute for Human Cognitive and Brain Sciences, [3] Department of Neurology - Massachusetts General Hospital and Harvard Medical School.

Occurrences of mind-wandering, i.e. shifting our attention from the external environment to our self-generated thoughts, are spontaneous, dynamic experiences that clearly illustrate the ever-changing identity of consciousness. For example it is a common experience that while driving, one moment our attention is focused on the road ahead and the next we find ourselves thinking of what we'll eat for dinner. Due to its subjective nature, first-person point of view measures like self-reports and experience sampling, such as stopping a participant in the middle of a task and asking him if he was focused on the task or distracted, have long been the state of the art for the study of self-generated thought. These methods, while managing to capture instances of this experience, lack of a way to objectively gauge the temporal dynamics of self-generated thought from a second- or third-person point of view without disrupting the experience itself. By building on a set of previous studies that used pupillometry as a marker of mind-wandering, we show that pupil diameter reliably predicts performance and self-generated thought reports in a task designed to induce periods of complete task focus and periods of self-generated thought in participants. Consequently, we discuss the advantages of pupillometry as a temporal marker of self-generated thought and its potential applications in everyday life.

P136 - Body Illusions: What Do They Really Tell Us About Our Bodily Awareness?

Lana Kühle [1]

[1] Illinois State University.

There's growing research exploring the dissociation of our bodily awareness from our own body — paradigmatic examples being the work on out-of-body experiences and on the rubber hand illusion. This research has given us important insights into how our sensory modalities shape our sense of embodiment, and raises important questions about our sense of ownership over our own body and the strength of our bodily awareness. Many of the findings from this research have been taken to show that our sense of body-ownership is very malleable and, as a result, our bodily awareness is not as strong as we might think. However, what do these results really tell us about our sense of body-ownership and our bodily awareness beyond the fact that these are malleable? Some have inferred that a malleable sense of body-ownership has consequences for one's sense of self as bodily, and that we might be reasonably led to question the strength of our sense of self as bodily given the ease with which we can be led to identify with another body, or part thereof. The underlying assumption here is that our sense of self as bodily is based on a sense of body-ownership. Thus, if our sense of body-ownership is easily manipulated, as is shown in cases of body illusions, then so too must our sense of self as bodily. I strongly disagree with this line of reasoning. I grant that our sense of body-ownership is related to our sense of self as bodily, however, I don't agree that our sense of self as bodily is based on our sense of body-ownership. To make this assumption, I argue, is to fail to acknowledge a key distinction between our awareness of our body as an object of perception and attention, and our awareness of our body as a subject of perception and action. Once we take this key distinction into account, we see that the evidence from body illusions is not supportive of the above-mentioned inferences that have been made on the basis of it. I contend that all we can infer from the evidence is that body illusions show us how malleable, weak, and unreliable our awareness of our body as an object can be. However, nothing can be inferred from this evidence alone about our awareness of our body as the subject of perception and action, which underlies our sense of self as bodily. Surely, it is important that we remain clear about what our empirical work can be properly said to show if we are to understand the complexities surrounding our bodily awareness and its relation to our sense of self.

P137 - “Who” felt the touch on my hand ?

Yen-Tung Lee [1], Wen-Yeo Chen [2], Hsu-Chia Huang [2], Sufen Chen [3], Caleb Liang [1,2]

[1] Department of Philosophy, National Taiwan University, [2] Graduate Institute of Brain and Mind Sciences, College of Medicine, National Taiwan University, [3] Graduate Institute of Digital Learning and Education National Taiwan University of Science, Taipei, Taiwan.

In this study, we investigated “experiential ownership” and its relationship to body ownership. While body ownership concerns what it is like to feel a body-part or a whole-body as mine, experiential ownership is about the sense that I am the one who is having a conscious experience (Liang et al., 2015). We conducted a set of experiments that involved both the rubber hand illusion (RHI; Botvinick & Cohen, 1998; Tsakiris & Haggard, 2005) and full-body illusion (FBI; Lenggenhager et al., 2007; Ehrsson, 2007): the participant wore a head mounted display (HMD) connected with a stereo camera set on the experimenter’s head. The subject saw the experimenter’s hand or whole body from the first-person perspective (1PP), and was touched synchronously or asynchronously...

P138 - A social neuroscience view on the body representation in Body Integrity Identity Disorder

Gianluca Macaudo [1], Peter Brugger [1], Bigna Lenggenhager [1]

[1] Neuropsychology Unit, Department of Neurology, University Hospital, Zurich, Switzerland.

Body Integrity Identity Disorders (BIID) or Xenomelia describes the condition, wherein afflicted individuals fail to accept at least one limb as their own. This often results in a desire for the amputation of that limb. Usually, the non-acceptance starts in early childhood and the desire for the amputation grows over the years. Although actual amputation has shown to lead to a substantial relief, ethical concerns, health risks and the lack of long-term studies call for less invasive therapeutic measures to alleviate this still poorly understood condition. Recent findings corroborate the notion of BIID as a heterogeneous and multi-dimensional condition that includes neurological, psychological and, importantly, also social factors. Using web-experiments and detailed questionnaires in a large sample of persons with BIID, we tried to better understand the link between their private and social body perception. The private body perception, i.e. individuals’ mental own body representation, was accessed with a body image task, and we used an adapted version of the implicit association task (IAT) to capture aspects of the social body. IATs are used to measure the implicit emotional and cognitive association between two concepts; in the present study we established the association of positive and negative words, and an amputated and complete body. Moreover, we collected several other measures such as the own body representation in dreams, and the Zurich Xenomelia Scale. While the analysis of the body image task did not show any consistent results, the IAT results suggest a clear implicit positive bias towards amputated bodies. This was significantly different from the response patterns of both healthy participants, and traumatic amputees, who served as control groups. Correlational analyses uncovered several interesting relationships such as an association between the duration of the desire and the body representation in dreams. The data present further evidence for an important social contribution to the condition of BIID and will be discussed within the frame of current views on the social bodily self. To conclude, these preliminary findings propose that BIID needs to be described on a more complex level in order to develop novel and efficient therapies.

P139 - Looking forwards: Understanding the significance of personal goals in the content of self-generated thought

Barbara Medea [1,2], Cristina Ottaviani [3], Jonathan Smallwood [1]

[1] Department of Psychology, University of York, York, United Kingdom, [2] Department of Psychology, Sapienza University of Rome, Italy, [3] IRCCS Santa Lucia Foundation, Rome, Italy.

Previous studies have shown that Self-Generated Thoughts (SGT, i.e. mental simulations based on previously acquired knowledge rather than current stimulus input) are intimately linked to prospective goal-directed thought suggesting they may be a vehicle through which we achieve goals that extend across time. Studies indicate that under non-demanding conditions the content of SGT reflect a focus on the future and reflect the processing of personal goal relevant information. Our study aims to investigate the relation between goals and spontaneous thoughts and specifically the effect of goal priming on thoughts content. To this aim participants completed a cognitive task following which they were allocated to think about their goals (experimental condition) or about their preferences towards TV programs (control condition) and then asked to complete the same cognitive task. The content of mind-wandering was assessed using experience sampling. Data analysis is still in progress. Quality of thoughts will be analysed by the use of principal component analysis. Results will be discussed in line with contemporary theories on SGT, goal-related thoughts and how these processes allow our species to transcend the moment and allow us to link who we are across time.

P140 - Conceptualising and Measuring Collective Cognition: Evidence for Distributed Cognition in Long Married Elderly Couples

Tom Morris [1], Amanda Barnier [1]

[1] ARC Centre of Excellence in Cognition and its Disorders, Department of Cognitive Science, Macquarie University, NSW, Australia.

Everyday remembering takes place in a rich environment of social interactions. Philosophers and cognitive scientists have argued for “distributed cognition”; the idea that human cognition extends into the world to incorporate physical and material resources (e.g., calendars) as well as social resources (e.g., friends). Consistent with this view, in psychology, Wegner (1987) proposed that long-term social groups develop “transactive memory systems” to share encoding, storage, and retrieval of information. He argued that groups become more than the sum of their parts; he argued for a form of group mind with emergent outcomes. This idea of collective cognition is increasingly of interest to experimental psychologists, neuroscientists, and others. But despite the claimed benefits of working together on cognitive tasks such as memory, experimental memory research typically has found that collaborating groups recall less than the same number of people working alone, an effect termed collaborative inhibition. In this presentation we report on a theoretical framework and a program of research that highlights instances where collaborative inhibition not only is eliminated but also reversed. Specifically, across a series of studies we have found that many long-married elderly couples show collaborative facilitation when they work with their spouse compared to working alone. Consistent with Wegner’s theory and the predictions of “distributed cognition” we have mapped at least three kinds of emergence in these groups: (1) emergence of new information; (2) emergence of qualitative different information (e.g., richer, more episodic); and (3) emergence of new understanding of the recalled events. Our results start to reveal why some kinds of groups, such as long-married elderly couples, show evidence of collective cognition (and collaborative benefits not costs) when others do not. We identify and discuss three key factors: (1) Alignment between members of the group (measured, for instance, by their intimacy); (2) Strategies that the group use to communicate (measured, for instance, by an analysis of collaborative processes); and (3) Cognitive Need of one or more members of the group (measured, for instance, by cognitive status), which helps to drive collective efforts. We argue that groups such as long married couples are best conceptualised as a persisting and integrated cognitive system and we describe the methods and results of our efforts to validate this view.

P141 - The influence of interoceptive signals on detection of 3D ballistic stimuli

Hielke Prins [1,2], Sarah Garfinkel [1,2], Keisuke Suzuki [1], Anil Seth [1,3], Hugo Critchley [1,2]

[1] Sackler Center for Consciousness Science, University of Sussex, Brighton, [2] Clinical Imaging Sciences Center, Brighton and Sussex Medical School, Brighton, [3] School of Informatics and Engineering, University of Sussex, Brighton.

Interoception refers to the sensation of internal bodily signals and is known to interact with emotion and cognition. Implicit bodily signals from the heart play an important role in sustaining a coherent image of the self and their neural representation has been proposed to contribute to the subjective dimension of perceptual experience. Visual feedback of cardiac activity increases the feeling of ownership over virtual limbs and whole virtual bodies. The timing of individual heartbeats furthermore influences the processing of emotional and threatening stimuli. For instance, fearful faces presented on heartbeat are rated as more intense and more readily detected during an attentional blink task, and fluctuations of ongoing brain activity due to cardiac activity correlate with hit rates. However, other studies have not always found an effect of cardiac timing on visual perception. We hypothesize that this might be due to their lack of ecological relevance to the observer and designed an experiment to test that hypothesis. According to influential theories of emotional decision making, interoceptive signals serve to guide behaviour by influencing the incentive value of stimuli. It follows that the effect of interoceptive signals on perception and action should be particularly pronounced for potentially threatening stimuli. To test this possibility, we asked whether responses to potentially threatening 'ballistic' stimuli are modulated by their appearance with respect to cardiac phase. Participants in our study are presented with 3D cone shaped stimuli that rapidly approach their face from various distances and are asked to respond as quickly as possible to the appearance of these stimuli. The looming character of approaching stimuli is known to elicit defensive responses that are enhanced when the stimuli are perceived as threatening. Preliminary results indicate that reaction times to the appearance of ballistic stimuli are indeed influenced by their timing within the cardiac cycle. Subjective ratings of the valence of the stimuli correlate with speed, size and initial distance of the stimuli but do not seem to interact with the main effect of cardiac timing. Our data so far suggests that early detection of stimuli is directly facilitated by interoceptive signals from the heart, as long as their detection is relevant enough to the observer to provide an incentive. The complete dataset will be presented at the conference.

P142 - Spontaneous brain dynamics and spontaneous thought: the impact of Gastric-Brain coupling

Craig G. Richter [1], Mariana Babo-Rebelo [1], Denis Schwartz [2], Catherine Tallon-Baudry [1]

[1] Cognitive Neuroscience Laboratory, Institut National de la Sante et de la Recherche Médicale (INSERM) - Ecole Normale Supérieure (ENS), 29 Rue d'Ulm, Paris, France, [2] Centre de NeuroImagerie de Recherche CENIR Hôpital Pitié-Salpêtrière, Paris, France.

The origin of spontaneous thoughts is likely to be found in the structure of spontaneous brain activity. In neuroscience, it is usually considered that spontaneous brain dynamics are constrained solely by properties intrinsic to the brain (e.g. anatomical connectivity, transmission delays). However, the brain constantly receives inputs from the viscera (Critchley & Harrison, Neuron 2013) that might play a role in anchoring thoughts in a subjective referential (Park & Tallon-Baudry, Phil Trans Roy Soc B 2014). Here we present evidence that spontaneous brain activity is constrained by an oscillatory generator extrinsic to the brain: the gastric pacemaker. The gastric pacemaker consists of specialized cells lining the stomach that generate an electrical oscillatory activity at ~0.05 Hz. The gastric pacemaker frequency is fixed for a given individual and independent from feedback from the central nervous system. We hypothesized that the gastric rhythm might impact slow amplitude fluctuations of spontaneous brain oscillations. To assess gastric-brain coupling we simultaneously recorded gastric (electrogastrogram, EGG) and neural (MEG) activity in 17 healthy subjects during 12 minutes of resting fixation. We assessed phase amplitude coupling between the amplitude envelopes of MEG activity in the 1–100 Hz range, and the EGG phase, using the modulation index (Tort et al., J Neurophysiol 2010). We found significant phase amplitude coupling between the gastric pacemaker and neural activity in the alpha frequency range. Source localization revealed gastric-alpha coupling to be constrained to an anterior and a posterior cluster. The anterior cluster was composed of the right anterior insula, a region that might be involved in self-awareness (Craig, Nat Rev Neuro 2009). The posterior cluster was centered

on the ventral precuneus and posterior cingulate cortex, two regions that belong to the default-mode network, extending dorsally in the precuneus, and posteriorly in the right parieto-occipital sulcus and right cuneus, as well as in the calcarine fissure bilaterally. The strength of gastric-alpha coupling in the posterior cluster correlated with subjects' propensity to daydream. Our results support the hypothesis of a role of the gastric pacemaker in shaping spontaneous brain dynamics, and potentially spontaneous thoughts.

TIME

P143 - Action as a unifier of perceptual experience

Andrea Desantis [1], Patrick Haggard [1]

[1] Institute of Cognitive Neuroscience UCL London.

Conscious experience requires the integration of sensory information processed by different senses. The integration of sensory modalities strongly depends on whether these modalities are perceived simultaneously. However, processing time might strongly differ between senses. Thus, the brain must be able to adapt to these differences and recalibrate its perception of synchrony. We report a study investigating whether the ability to predict the specific auditory and visual outcomes that an action produces, promotes recalibration of our perception of audiovisual simultaneity. We show that auditory and visual components of an audiovisual outcome are perceived simultaneously when this outcome is predicted compared to when it is unexpected. This suggests that action control processes promote the integration of predicted auditory and visual outcomes into a single audiovisual event. Actions structure the perception of our environment to creating a coherent representation of the external world.

P144 - Inverted Time Perception, Understandings from EEG and fMRI

Dr Francesco Giorlando [1,2], Shikha Markanday [3], James Dahler [4], Dr Andrew Anderson [5], Prof Paul Fletcher [7], Prof Michael Berk [1,2,3,8,9]

[1] Department of Psychiatry, University of Melbourne, Parkville, Victoria, Australia, [2] Orygen Youth Health Research Centre, Centre for Youth Mental Health, Parkville, Victoria, Australia, [3] Barwon Health and the Geelong Clinic, Swanston Centre, Geelong, Victoria, Australia, [4] Barwon Health Neurology, Geelong, Victoria, Australia, [5] Department of Optometry and Vision Sciences, University of Melbourne, Parkville, Victoria, Australia, [7] Department of Psychiatry, Cambridge University, Cambridge UK, [8] IMPACT Strategic Research Centre, School of Medicine, Deakin University, Geelong, Victoria, Australia, [9] The Florey Institute for Neuroscience and Mental Health, Parkville, Victoria, Australia.

All perception is embedded within a temporal frame. From the flow of everyday events to coordination of movement and encoding of memory, a reliable temporal coding underlies our everyday experiences. When this temporal coding breaks down, it results in temporal disintegration, a form of dissociative experience. We sought to study alterations in temporal perception by the use of an illusion of time, the temporal inversion effect. When flashed stimuli (duration 20ms, ISI 60ms) are presented close to the onset of rapid eye movements, it is possible to induce a percept in which the second flashed stimulus appears to precede the first. We explored the neural correlates of this perceptual effect with the use of fMRI and EEG. The research reported involved two studies, an fMRI study with 22 participants in which participants were given ketamine/placebo, and an EEG study with 16 patients with bipolar disorder. Participants observed a series of flashed visual stimuli timed to coincide with eye movements. They were asked to make a judgement of which flash came first. It has previously been shown that presenting this type of stimulus close to the onset of eye movements causes temporal inversion (Morrone et al. 2005), the second flash is perceived before the first in a proportion of trials. Participants reported dissociative and temporal symptoms with the Temporal Integration Inventory (TII) and the Clinician Administered Dissociative States Scale (CADSS). The fMRI results revealed that there are two key networks of brain regions involved in the temporal inversion effect, an anterior network involving bilateral claustra, insulae and medial cingulate cortex and a posterior region involving the temporoparietal junctions. The temporoparietal junction activity on the left correlated with TII score and on the right with CADSS score (Pearson's $r = 0.64$ and $r = 0.54$ respectively, $p < 0.05$). The EEG measures in the bipolar

group showed a significantly altered evoked potential for inverted trials 0.3 - 0.9 s after the stimuli (left fronto-central electrodes, $p < 0.05$). These results reveal specific alterations in brain responses to the temporal inversion illusion. We demonstrated both EEG and fMRI correlates of these changes. Furthermore, we found that these neural correlates were associated with measures of temporal disintegration and dissociation in specific regions. These findings provide evidence for a distributed temporal perception system.

P145 - A long minute: subjective time quantification

Sabai A. Ramedhan-Levi [1], Xiaho Song [2,3], Ariel B. Lindner [2,3]

[1] Independent artist and architect, Paris, France, [2] Faculty of Medicine, Paris Descartes University, [3] Systems Engineering and Evolution Dynamics team, INSERM unit 1001, Paris, France.

Universal measurement units provide a common conventional framework to which we accommodate daily. Here, we measure how robust is humans' perception of a relevant and recurrent time frame – a subjective 1 minute, with respect to physical (objective) time. We aim at providing empirical data for better understanding of the cognitive, physiological basis of minute-scale estimations for which relatively scarce large datasets currently exist. To this end we developed a novel protocol that can be performed in any setting, providing scalability necessary for a citizen science, crowd-sourcing approach. Participants, either as individuals ($N=146$), or within a single cohort ($N=51$), are requested to sit still and close their eyes for what they perceive as one minute. They are suggested not to count. The protocol assures isolation from visual signals and leaves participants to concentrate on inner cues. Video capture provides documentation to determine the subjective minute and potential physiological determinants. We find that the variance of same-participant subjective minute is significantly smaller than amongst participants, suggesting the methodology depicts faithfully individual subjective minutes...

P146 - Time perception in pre-recorded reality: testing whether the speed of natural scenes affects subjective duration of time under different sensorimotor conditions

Keisuke Suzuki [1,2], Hielke Prins [3], Anil Seth [1,2]

[1] Sackler Centre for Consciousness Science, University of Sussex, Brighton, BN1 9QJ, UK, [2] School of Informatics and Engineering, University of Sussex, Brighton, BN1 9QJ, UK, [3] Brighton and Sussex Medical School, Brighton, UK.

The experience of time passing is a fundamental but elusive aspect of conscious experience. In vision, subjective time perception is known to be influenced visual features including stimulus motion. Recently, attention has recently also focused on the influence of action on time perception. For example, subjective intervals between action onsets and their outcomes are perceived as shorter for volitional action, this being "intentional binding". Temporal intervals separating two tactile stimuli on a moving hand are furthermore perceived as shorter than those applied to a static hand (Tomassini et al., 2014, J Neuro). This latter effect seems to depend on efferent motor signals and not on afferent visual feedback, since subjective compression of the interval still occurs when the moving hand is mechanically restrained. Although motor action and low-level visual features both exert influences on time perception, they are often studied in isolation and the stimuli usually bear little resemblance to real life situations. We set out to investigate the intimate links between time perception, visual stimulus properties, and motor action. We developed a paradigm implementing uniquely naturalistic conditions, where we manipulate the sensorimotor coupling between head motion and visual feedback in an immersive natural environment. Participants are exposed to video material from a 360° panoramic camera by means of a head mounted display. This setup allows exploration of pre-recorded environments using head movements that are nearly indistinguishable from real life, generating strong impressions of immersion and subjective reality (Suzuki et al., 2012, Sci Rep). In the present study, the playback speed of the panoramic video sequences was increased or decreased, and participants were instructed to rest or make head movements while watching them. We reason that these manipulations will have distinct effects on subjective perception of time, as quantified using an interval comparison task. Specifically, we predict that head movements will shorten the perceived duration of scenes, while increased playback

speeds will dilate them. The results, to be presented at the conference, will provide insight into the interaction between afferent and efferent signals that contribute to the subjective perception of time.

P147 - Voluntary actions modulate the experience of time

Matti Vuorre [1], Janet Metcalfe [2]

[1] Columbia University.

Relative to the objective time of occurrence, voluntary actions and their effects are judged as having occurred closer together in time (Haggard, Clark, & Kalogeras, 2002). We asked whether the subjective temporal binding of voluntary actions and their effects reflects a bias in memory, or a change in the perceptual experience of time. If the action-effect binding reflects a change in the perceptual experience of time, we expected voluntary actions to lead to changes in how a temporally sensitive visual illusion is seen. We tested this hypothesis using apparent motion, a visual illusion in which two static objects appear as one moving object if the inter-stimulus interval is short enough—just as static images result in movies if displayed with a high enough frame rate. If voluntary actions modulate the perceptual experience of time, not only retrospective reports about it, we predicted that subjects would perceive apparent motion more frequently in the voluntary action condition, because the inter-stimulus interval would be subjectively shorter. Subjects observed two successive visual stimuli either following voluntary action, or no action, and then reported whether they saw apparent motion, or estimated the inter-stimulus interval (ISI). We replicated previous findings, showing that voluntary actions lead to shorter retrospective duration estimates, but also found that voluntary actions increased the rate of perceiving apparent motion. Our findings show that voluntary actions modulate the perceptual experience of time, making subsequent durations shorter in perceptual awareness and verbal reports.

P149 - Temporal distortion in the perception of actions and events

Yoshiko Yabe [1,2], Hemangi Dave [3], Melvyn A. Goodale [1]

[1] Brain and Mind Institute and the Department of Psychology, University of Western Ontario, [2] Research Institute, Kochi University of Technology, [3] the Department of Physiology and Pharmacology, University of Western Ontario.

We recently showed that when a sensory event triggers an action, we perceive the event to occur later than it really does (Yabe & Goodale, *Journal of Neuroscience*, in press). Previous studies have shown that when we make our action results in a sensory event, we perceive the event to have occurred earlier than it really did (Haggard et al., 2002). Events and actions are temporally bound to each other (intentional binding). It is not known, however, whether or not binding occurs when multiple events and actions occur alternately. In this study, we compared the temporal binding in an event-action-event (EAE) sequence to binding in an event-action (EA) sequence. Participants viewed a black dot displayed on a computer screen. A hand rotated around the dot like a conventional clock. In both conditions, participants were required to respond to a tone by making a hand-movement. In the EAE condition, another tone followed the elicited hand-movement. In the baseline condition, the participants heard the same tone, but were not required to respond. At the end of each trial, participants were required to report the location of the clock hand at the moment the tone occurred. We found that the perceived timing of the event in EA sequence was later than when the event was passively observed in the baseline condition, consistent with our previous study. In contrast, the perceived timing of the first event in EAE sequence was not significantly different from that observed in the baseline. The results suggest that the perceived timing of events triggering actions is sensitive to sensory events following the actions.

Friday, July 10th
(11:00 – 12:30)

ACTION & VOLITION - II

P150 - Dyadic and Mobile Brain Imaging: Implications for Consciousness Research

Tarik Bel-Bahar [1,2], Uncheol Lee [1,2], Joon Moon [1,2], George Mashour [1,2]

[1] Center for Consciousness Science, [2] Department of Anesthesiology, University of Michigan Medical School.

Advances in realistic models of consciousness-in-action will come from examining neuropsychological dynamics in mobile and interpersonal contexts. Embodied human cognition requires interactions with a range of objects and people in the world. Further, psychological theories have long emphasized the social-interactive roots of self-awareness and self-representation. In order to explore cognition in these unexplored contexts, we recorded simultaneous dense-EEG from ten pairs of participants while they performed a motivated interaction protocol. During each recording session, one pair of participants stood and moved in front of each other, searched as a team with their hands for spatial targets, and received an auditory reward feedback when the spatial targets were found. During each experimental block, the participants switched between the roles of leader and follower, and they had to keep two of their hands (e.g., the leader's left hand and the follower's right hand) within two inches of each other during the spatial target search. ICA-based decomposition of the EEG data showed a set of occipital, sensorimotor, and mid-frontal sources that were activated during the protocol across all participants. Increases were observed for event-related medio-frontal theta in response to the rewarding auditory feedback during the leader condition relative to the follower condition. Exploratory analyses include single- and dyadic-brain connectivity and network metrics. Overall the results confirm the growing database of studies showing that EEG-derived brain dynamics can be examined in mobile protocols. Implications for a better understanding of individual and dyadic consciousness are discussed in light of the present findings.

P151 - Sense of agency for thoughts and working memory disorders. A neurophenomenological perspective

Leon Ciechanowski [1,2]

[1] Department of Psychology, University of Social Sciences and Humanities, Warsaw, Poland, [2] Department of Philosophy, University of Warsaw, Warsaw, Poland.

In this paper I analyze the suggestion of early neurophenomenology (Gallagher & Varela 2001; Gallagher 2004), which states that problems with mistaken attribution of thoughts in schizophrenics are not caused by malfunctions on the higher-order conceptual level, nor on the "middle-way" level of efferent signals losing their way. Neurophenomenologists suggested that the problem lies on the neurological level and that it is connected with failures of the anticipatory aspect of working memory (WM). These failures are supposed to manifest themselves in the pre-reflective structure of phenomenal experience, especially in the case of inserted thoughts (Frith 1992). I begin with a brief general introduction of the sense of agency (SoA), then I shortly present the neurophenomenological account of SoA, show how this model postulates the connection of SoA and WM. After describing the problem of SoA for thoughts I argue for the terminological change of the label 'inserted thoughts' and claim that they should be rather treated as 'autochthonous thoughts'. Basing on experimental data, I claim that only after combining different domains like executive functions, contextual factors, emotions, affectivity and SoA, we can account for SoA disturbances in the light of WM disorders.

References:

Frith, C., 1992. The cognitive neuropsychology of schizophrenia. Lawrence Erlbaum. Gallagher, S.,

2004. Neurocognitive models of schizophrenia: a neurophenomenological critique. *Psychopathology*, 37(1), pp.8–19.

Gallagher, S. & Varela, F., 2001. Redrawing the map and resetting the time: Phenomenology and the cognitive sciences. In S. Crowell, L. Embree, & S. J. Julian, Eds. *The Reach of Reflection: Issues for Phenomenology's Second Century*. Electronpress, pp. 17–43.

P152 - Probing Folk-Psychology: How Consciousness and Intentions Influence Beliefs about Free Action

Robert Deutschländer [1], Michael Pauen [2], John-Dylan Haynes [1,2,3]

[1] Bernstein Center for Computational Neuroscience, Charité – Universitätsmedizin, Berlin, Germany, [2] Berlin School of Mind and Brain, Humboldt-Universität zu Berlin, Berlin, Germany, [3] Berlin Center of Advanced Neuroimaging, Charité – Universitätsmedizin, Berlin, Germany.

There is an ongoing debate as to when people believe an action to be free. Two criteria are frequently discussed as important: That a person has an intention prior to the action and that they are consciously aware of this intention. In order to investigate which criteria laypeople commonly adopt, we probed intuitions about free actions based on daily life scenarios. In an online survey of 471 subjects we found that both 'prior intention' and 'consciousness' have an impact on the assessment of free action. Interestingly, we found that a main factor determining freedom was that an action did not go against a person's will, whereas it played only a minor role whether an action was explicitly wanted or whether a person was indifferent to the action. The judgments were very similar for two different types of actions, one being a homeostatic action (drinking water) and one a cultural activity (reading a book). We found a divergence of ratings in our sample. Some participants put more emphasis on consciousness, some on prior intentions, and others indifferently judged all actions to be free. This diversity of beliefs might underlie common disagreements in discussions about free will.

P153 - Investigating cue integration in intentional binding

Hannah Limerick [1], David Coyle [1,2], James W Moore [3,4]

[1] Department of Computer Science, University of Bristol, [2] School of Computer Science and Informatics, University College Dublin, [3] School of Experimental Psychology, University of Bristol, [4] Department of Psychology, Goldsmiths, University of London.

The sense of agency is the experience of initiating actions to influence the external environment. In recent years there has been an increasing consensus that optimal cue integration is a central process in estimating the agentic source of an action and its consequent outcome. Here, the variability of estimating the agentic source of an action is reduced by optimally integrating multiple agency cues. Agency cues consist of internal sensorimotor cues and external inferential information, which are thought to be weighted by their reliability and conditional upon prior expectations. Intentional binding is a temporal phenomenon where the perceived action-outcome interval for voluntary actions is shorter than for equivalent passive movements (e.g. Haggard, Clark & Kalogeras, 2002). It is taken to be an implicit measure of sense of agency (Moore & Obhi, 2012). The underlying processes for intentional binding are relatively unknown, however evidence is growing that inference and prediction are central and that cue integration is a candidate mechanism for this phenomenon (Moore & Fletcher 2012). Measuring intentional binding requires participants to provide temporal estimates for their actions and the consequent outcomes. In this task, these estimates are based on the two temporal cues – action event and outcome event. According to recent work (Wolpe et al, 2013), temporal estimates of action and outcome are based on the integration of the available cues, weighted by reliability. This may explain why the two events are temporally attracted towards one another, i.e. the cues associated with each event are integrated together. Here we tested the impact on intentional binding of providing additional visual cues concerning the onset of action. We hypothesized that this would have two effects: action binding would decrease and tone binding would increase. Our results show that the provision of additional cues regarding the onset of action significantly reduced the variability of temporal estimates for the action events, which is in line with the cue integration hypothesis. Furthermore, the binding results suggest that only action binding was affected. This suggests that action binding, but not tone binding,

was influenced by changes in action reliability. Our findings support the idea that separate mechanisms underpin action and tone binding; where action awareness is sub-served by an inferential cue integration mechanism.

P154 - Veto mechanism of consciousness

Ken Mogi [1]

[1] Sony Computer Science Laboratoires, Tokyo.

One of the functional significance of consciousness is to veto possibly non-adaptive actions. It has been proposed that there are three different components of decision-making (what, when, and whether, Brass and Haggard 2008). Out of these elements, the “whether” component comprises the temporarily last and functionally significant element of decision making. If a particular action is considered to be maladaptive, it makes sense to veto it, even if neural resources have already been employed for the preparation and execution of the what and when factors. The veto mechanism is one of the epitomes of the functionality of consciousness. In order to conduct a successful veto operation, the brain needs to analyze and integrate various factors contributing to the pros and cons for the action. This involves the integration of massively parallel information flow in real time. How the brain achieves this process is one of the most important and interesting aspects of cognition, in the context of both conscious and unconscious information processing. Here I present a model in which the integration of affecting factors in the veto mechanism is given a common basis with the integration of sensory information in the presence of sensory overflow (Block 2011, Lau & Rosenthal 2011). This model would aim to treat the brain’s successful information handling from the sensory to the motor in a coherent scheme. In order to successfully deal with the presence of massively parallel overflow, some elements become essential. One is categorization. A subset of information needs to be given a categorical treatment, making it possible to deal with them in a compact way (i.e. the “gist” perception in sensory information). The other is priority giving. The brain handles the latter task by means of attentional dynamics, which can be applied to both sensory and motor information. Based on the model, I analyze the computational complexity involved in the execution of the veto mechanism of consciousness. This analysis sheds light on the evolution of consciousness in the presence of overflow in the sensory and motor domains, and reveal how the evolution of consciousness has contributed to the improvement of adaptability in the biological agents. Finally, I discuss the possible applications of the brain’s veto mechanism to the control problems of artificial intelligence, making the artificial systems less prone to make runaway operations.

P155 - Sense of agency for others’ actions relies on external consequences rather than predictions: Implications for determining agency for ourselves and others

Simmy Poonian [1, 3, 4], Ross Cunnington [1, 2]

[1] Queensland Brain Institute, The University of Queensland, Brisbane, Australia, [2] School of Psychology, The University of Queensland, Brisbane, Australia, [3] Université Paris Descartes, Sorbonne Paris Cité, Paris, France, [4] CNRS (Laboratoire Psychologie de la Perception, UMR 8242), Paris France.

The knowledge that I caused a consequence to occur relies on our ability to predict the consequences of our own actions and distinguish them from the actions and consequences of other agents. The question remains as to whether we attribute agency for other agents in a similarly predictive manner as has previously been found for our own actions. Using an implicit measure of sense of agency, the likelihood of an auditory consequence occurring after a self-made or observed action was varied. We show that agency for others’ actions depends critically on the presence of external consequences following the action. This is in contrast to the role predictive processes have in the sense of self-agency we form when executing our own actions. We suggest that different weightings of internal predictions and external cues are used in order to correctly attribute agency over action-effects to ourselves or to another agent.

P156 - New avenues for investigating a prospective sense of agency

Nura C. Sidarus [1], Janet Metcalfe [2], Patrick Haggard [1]

[1] Institute of Cognitive Neuroscience, University College London, UK; [2] Columbia University, USA.

The sense of agency refers to the feeling that we are in control of our own actions and, through them, of events in the outside world. Many studies have shown the importance of a retrospective comparison between the expected and actual consequences of our actions. When there is a mismatch, and something that we did not expect happens, our sense of agency is reduced. Recent studies have revealed an additional, prospective component to the sense of agency, related to a metacognitive signal about the fluency of action selection. When action selection is fluent, and we “know just what to do”, our sense of agency over the consequences of our actions is stronger than when action selection is dysfluent, or difficult. We present evidence that these effects can transfer across paradigms used to manipulate action selection, from subliminal action priming, to the Eriksen flanker task, to a video game-like paradigm.

P157 - “What, When, Whether - the electrophysiological correlates of voluntary action in virtual environment

Konrad Stanek [1,2], Ole Winther [1], Steffen Angstmann [2], Kristoffer H. Madsen [2], Hartwig R. Siebner [2]

[1] Technical University of Denmark, DTU Compute, Cognitive Systems, Denmark, [2] Danish Research Center for Magnetic Resonance, Hvidovre Hospital, Denmark.

The study of (Libet 1985) gave rise to active discussion among scientists over the nature of free-will and conscious voluntary action, suggesting that, at least in certain circumstances, an intention to perform voluntary action can be predicted from prior neural activity. (Brass and Haggart 2008) proposed to distinguish three different classes of voluntary decisions: “what” type of action to perform, “when” to act, and “whether” to act or not. Those distinct decisions might involve different neural pathways and anatomical regions (Brass 2013, Mueller 2007, Kriehoff 2009), including medial pFC, ACC, preSMA and SMA, PMC, and parietal cortex. In our study we confront participants with the three classes of decisions in more natural, yet still strictly controlled experimental setup, involving navigating a car through a virtual environment. By adopting the virtual environment, rather than abstract pictogram-based stimuli, we intend to provide more natural platform for analysis of neural correlates of voluntary action, and avoid common problems such as random sequence generation behavior (Jahanshahi 1999) and lack of external validity (Haggart 2008). Each of the 16 participants performed 840 voluntary decisions split into blocks corresponding to “what” (left/right turn), “when” (first/second crossroad), “whether” (turn or do not turn), and “control” (do not take any decisions). The decisions were time-locked to the intervals when car was passing through tunnels with stable visual field and constant luminance. High-resolution EEG data was acquired with 128-channel Biosemi ActiveTwo system. Oculo-motor activity was recorded with SMI eye-tracking system and synchronized with EEG signals. For each participant we acquired structural MR brain image (3T Philips), and recorded electrode coordinates with Localite neuro-navigation system. We demonstrate electrophysiological differences in activation of brain regions related to the aforementioned classes of decisions, in terms of timing, spatial distribution and time-frequency modulation of lower (theta/alpha) and higher (gamma) frequency bands, time-locked to the onset of the decision intervals. This event-related modulation of EEG signals, along with subject-specific T1 images, session-specific electrode coordinates, and set of spatial filters are then used to localize and characterize decision-relevant neuroanatomical sources distributed over prefrontal, anterior cingulate, motor and parietal cortical regions.

P158 - Detecting traces of consciousness in the process of intending to act

Ceci Verbaarschot [1], Jason Farquhar [1], Pim Haselager [1]

[1] Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen, The Netherlands.

Research on intentional action is often based on the experiment of Libet et al. (1983), using post-action reports on the awareness of intending to act. To the best of our knowledge, Matsushashi and Hallett (2008) are the only ones to have tried a different approach by using auditory probes to ask subjects in real-time whether they are aware of their intention to act. With this method they identified awareness of intending to act as early as 1.42 s prior to action onset, whereas Libet et al. found it only 0.2 s prior to the act. This timing difference was verified in a within-subject experiment combining both experimental designs (Verbaarschot, Haselager & Farquhar, in prep). If one takes 'intentions' to be discrete mental states occurring at a single point in time, these results seem to be at odds with each other. However, they fit very well within a framework in which intentions are regarded as processes developing over time. While the later stages in this process of intending are available for self-initiated report, early stages appear to be reachable and reportable through external probing only. We combine knowledge from theoretical cognitive science, neuroscience and brain-computer interfacing in order to investigate this process of intending. During my talk, I would like to present a new theoretical framework in which intending to act is described as a multistage process developing over time. This framework is linked to multiple neuroscientific results, including our own empirical findings on subjective experience during the different stages of intending. In our research, we step away from the typical Libet-type experiment, where acts are more likely some arbitrary movement than a true intentional act. We aim for a more ecological valid experimental design in which acts can be made for a reason and are followed by some effect. Furthermore, we investigate the relationship between the neural preparatory processes for action (i.e. the Readiness Potential and alpha/beta event-related desynchronization over the motor cortex) and the reported awareness of intending to act using EEG. Assumptions underlying any claim regarding the nature of the relationship between these processes of acting and intending are critically evaluated. For instance, we will illustrate how seemingly innocuous technical details are actually crucially relevant to the debate surrounding the interpretation of Libet-style experiments (Verbaarschot, Farquhar & Haselager, 2015).

ALTERED STATES OF CONSCIOUSNESS - II

P159 - In conversation with high hypnotizable people: Developmental trajectories, correlates, and sense of agency

Professor Amanda J. Barnier [1]

[1] Australian Research Council Centre of Excellence in Cognition and its Disorders and Department of Cognitive Science Macquarie University Sydney, NSW 2109 Australia.

Hypnotic phenomena are controllable alterations in consciousness; hypnosis can create experiences that feel surprisingly easy and surprisingly real. The science of hypnosis has been shaped by a long history of conversation and collaboration between researchers and talented hypnotic people. Yet we still have much to learn about developmental trajectories, correlates of superb hypnotic performance, and the disruptions in sense of agency that characterize the experiences of high hypnotizable people. I describe a program of experimental psychology research on building blocks of hypnotizability and on feelings of agency inside and outside hypnosis. I recommend three directions for future research on hypnotizability: developmental studies, component- and performance-based correlates, and models of helpful and unhelpful agency disruption. Such investigations will not only help to reveal the essence of hypnotic behaviour and experience but will inform the use of hypnosis in models of consciousness, action, and belief, both normal and abnormal.

P160 - Altered temporal dynamics of EEG microstate sequences during pharmacologically induced loss of consciousness

Juliane Britz [1,2], Julien Maillard [3], Miralena Tomescu [2], Christopher Lysakowski [3] Christoper Michel [2], Dimitri van de Ville [4,5], Martin Tramèr [3]

[1] Department of Psychology, University of Fribourg, Fribourg, Switzerland, [2] Department of Fundamental Neuroscience, University of Geneva, Geneva, Switzerland, [3] Department of Anesthesiology, University Hospital, Geneva, Switzerland, [4] Department of Radiology, University Hospital, Geneva, Switzerland, [5] Institute of Bioengineering, Ecole Polytechnique Fédérale, Lausanne, Switzerland.

The EEG topography is a global measure of the momentary brain state, and its configuration remains stable for brief periods (~70 – 100 ms), with rapid transitions from one stable scalp field topography into another – the so- called EEG microstates. Their temporal dynamics and local syntax are altered in different neurological and psychiatric conditions, and they are malleable by psychotropic drugs, which lead to the hypothesis that they constitute the “basic building blocks of cognition” or “atoms of thought” underlying spontaneous conscious cognitive activity. Using simultaneous EEG/fMRI, we have previously shown that the temporal organization of EEG microstate sequences show long-range temporal correlations and is monofractal over 6 dyadic scales covering the range from 256 ms to 16 s, which we postulated to be a necessary prerequisite for consciousness. In the present study, we assessed EEG microstate dynamics of the gradual loss of consciousness (LOC) during the step-wise induction of general anesthesia with Propofol. Subjects were adults undergoing elective surgery requiring general anesthesia. Prior to Propofol administration, 5 min of resting EEG (64 channels (acticap, BrainProducts)) were recorded as a baseline. Propofol was administered intravenously with an initial cerebral concentration of 0.5 µg/ml, followed by stepwise increases (1.5 µg/ml, 2.5 µg/ml, 3.0 µg/ml, 3.5 µg/ml, 4.0 µg/ml, etc.) until LOC. At every level of sedation, 5 min of resting EEG were recorded once the equilibration of blood-Propofol concentration was reached, and the clinical assessment of patient consciousness was performed every minute using the Observer Assessment of Alertness/Sedation Scale (OAA/S). Long-range temporal correlations of EEG microstate sequences as indicated by the Hurst Index decreased significantly both as a function of clinical assessment of consciousness (OAA/S) and Propofol concentration, which indicates that that this feature might indeed reflect an objective measure of conscious awareness.

P162 - Bayes to the rescue: Does the type of hypnotic induction matter ?

Jean-Rémy Martin [1], Zoltan Dienes [1, 2]

[1] School of Psychology, University of Sussex, Brighton, UK, [2] Sackler Centre for Consciousness Science, University of Sussex, Brighton, UK.

It has been claimed that the global state of consciousness can be changed by hypnotic inductions. The hypnotic state induced is, on a strong version of state theory, facilitatory of response to hypnotic suggestions, i.e. suggestions for changes in experiences of volition and reality. By contrast, some authors argue that hypnosis does not amount to a specific state of consciousness, and correspondingly, the type of hypnotic induction has no effect on responsiveness to suggestion (Brafman & Kirsch, 1999; cf Banyai & Hilgard 1976). The altered state experienced by subjects may be just the response to a suggestion, i.e. the suggestion for an altered state. On this theory, what is crucial and interesting about hypnosis is how some people can alter their sense of volition and reality (Dienes and Perner, 2007). In the present paper we re-evaluate the effectiveness of different forms of inductions on responsiveness to suggestion. Studies having compared, for instance, the effect of active inductions –in which people performing some physical activity are given suggestions of alertness, attentiveness and freshness– versus traditional inductions –in which people staying at rest are given suggestions of relaxation and drowsiness– on responsiveness to suggestion found no difference between the two conditions (Banyai & Hilgard 1976; Malott 1994). It could therefore be concluded that the form of hypnotic inductions does not matter and that, by extension, what matters is only that the subjects understand this is a situation to use their hypnotic skills. However, these studies present an important shortcoming: they draw their conclusion(s) from non-significant results. Now, within the context of orthodox statistics we cannot draw any conclusion from a non-significant result. In contrast, Bayesian statistics have developed specific statistic tools such as Bayes factors (Dienes, 2014) which give us the possibility to decide whether a

non-significant result is evidence for the null, evidence for the alternative or whether data are simply insensitive. In the present paper we review the studies having found non-significant results testing different forms of inductions and we apply Bayes factors to these null-results in order to draw the right conclusion: does the form of hypnotic inductions really not matter, does it matter or should we suspend judgment? The results bear on theories of the global nature of consciousness and the nature of hypnotic response.

P163 - Investigating auditory false perceptions in a non-clinical sample

Peter Moseley [1], David Smailes [2], Amanda Ellison [2], Charles Fernyhough [2]

[1] University of Central Lancashire, [2] Durham University.

Auditory verbal hallucinations (AVHs) are the conscious perception of a voice in the absence of any speaker. They are typically associated with a diagnosis of schizophrenia, but are also associated with a number of other diagnoses, as well as occurring in the healthy population. Prominent cognitive models have linked AVHs to atypical processing of inner speech or auditory imagery, such that they may become misattributed to an external source. One paradigm that has been commonly used to assess false perceptions in both clinical and non-clinical samples is the auditory signal detection task, which requires the participant to detect a voice presented in random noise. Typically, individuals who experience hallucinations tend to falsely detect more voices in the task. We conducted a number of studies in a non-clinical sample, using this paradigm to explore the cognitive and neural mechanisms underlying false perceptions in signal detection, showing that i) using auditory verbal imagery concurrently with signal detection lowers response bias, ii) this effect is specific to individuals who report more frequent hallucinatory experiences in everyday life, and iii) performance can be modulated by transcranial stimulation of the left superior temporal gyrus in a polarity dependent manner. This provides support for contemporary cognitive models of hallucination-proneness, which suggest they may be related to a tendency to misattribute internally-generated events, such as inner speech, to an external source.

P164 - The cognitive response to complex naturalistic stimuli in states of incremental sedation

Lorina Naci [1], Mimma Annello [2], Alex MacDonald [3], Shakib Naqshbandi [2], Miguel Arango [3], Christopher Harle [2], Adrian M. Owen [1]

[1] The Brain and Mind Institute, Department of Psychology, University of Western Ontario, London, Canada, [2] Schulich School of Medicine and Dentistry, University of Western Ontario, London, Canada, [3] Faculty of Medicine, University of Toronto, Toronto, Canada.

Anesthesia provides a controlled manipulation for abolishing consciousness in a reliable manner in healthy individuals. When combined with functional neuroimaging, it provides a unique approach for studying the brain mechanism of consciousness and how they go awry when consciousness is lost. The majority of anesthesia studies have used a stimulus- and task-free paradigm, known as the resting state, to investigate changes in neural activity as the brain transitions from the wakeful to the anesthesia-induced unconscious state. However, these studies cannot address the question of how processing of external information that evolves over time is affected by sedation. For the first time, we investigate the cognitive response to complex naturalistic stimuli in states of incremental sedation, from awake, to mild, and to deep sedation, a state characterized by lack of behavioural responsivity. We used a novel paradigm that presented a rich, auditory narrative to participants (N=17) in the functional Magnetic Resonance Imaging (fMRI) scanner. The level of propofol sedation was assessed with the Ramsay clinical scale (Ramsay 1974). Assessments of Ramsay 1, 3, or 5 determined awake, mild, or deep sedation, respectively. Perception and higher-order cognition were investigated by modelling the fMRI response with Statistical Parametric Mapping. Independent Component Analysis further characterized brain networks...

P165 - The neural correlates of the emergence from disorders of consciousness

Carol Di Perri [1], Mohamed Ali Bahri [2], Enrico Amico [1], Aurore Thibaut [1], Athena Demertzi [1], Lizette Heine [1], Marie Aurelie Bruno [1], Vanessa Charland-Verville [1], Sarah Wannez [1], Francisco Gomez [3], Roland Hustinx [4], Luaba Tshibanda [5], Andrea Soddu [6]*, Steven Laureys [1]*

***Contributed equally**

[1] Coma Science Group, Cyclotron Research Centre, University and University Hospital of Liège Liège, Belgium, [2] Cyclotron Research Centre, University and University Hospital of Liège Liège, Belgium, [3] Complexus Group, Computer Science Department, Universidad Central de Colombia, Bogotá, Colombia, [4] Nuclear Medicine Department, University Hospital of Liège Liège, Belgium, [5] Department of Neuroradiology, University Hospital of Liège Liège, Belgium, [6] Brain and Mind Institute, Department of Physics & Astronomy, , University of Western Ontario, London, ON, Canada.

Background - Between severely impaired consciousness, as in disorders of consciousness (DOC, i.e. vegetative state/unresponsive wakefulness syndrome -VS/UWS-, minimally conscious state -MCS-) and normal consciousness (healthy controls) there is a scarcely researched transition zone belonging to those patients who regain capacity for functional communication and/or object use (i.e., emergence from minimally conscious state; EMCS). We here investigated brain metabolism, grey matter volume and positive/negative resting state functional connectivity in the transition from DOC to normal consciousness (healthy controls).

Methods - We acquired FDG-PET, structural MRI and resting-state functional MRI in 58 severely brain injured patients (23 VS/UWS, 21 MCS, 14 EMCS) and 35 healthy controls. We applied voxel-based analyses and seed-based positive connectivity studies within the default mode network (DMN) and negative connectivity (i.e., anti-correlations) between the DMN and the task positive network (TPN). We compared brain metabolism with positive and negative connectivity.

Findings - The metabolism and grey matter volume of the medial and lateral fronto-parietal regions were correlated with the levels of consciousness. Compared to MCS, EMCS showed higher metabolism in precuneus and left frontoparietal cortices. Grey matter volume and positive connectivity within the DMN could not disentangle EMCS from MCS. Negative connectivity between DMN and TPN discriminated EMCS from MCS. DOC patients showed a pathological positive connectivity between these two networks, whilst EMCS exhibited a negative connectivity similar to that observed in controls. Brain metabolism correlated with positive connectivity within the DMN and with negative connectivity between DMN and TPN.

Interpretations - Emergence from MCS does not correlate with the reestablishment of positive connectivity within the DMN but with the partial recovery of negative connectivity (i.e., anti-correlation) between DMN and TPN. Negative connectivity correlated with metabolic activity and seems to play an important role in the recovery of cognitive functioning after severe brain damage.

P166 - Complexity of multi-dimensional spontaneous EEG decreases during propofol induced general anaesthesia

Michael M. Schartner [1], Anil K. Seth [1], Quentin Noirhomme [2], Melanie Boly [3], Marie-Aurelie Bruno [2], Steven Laureys [2], Adam B. Barrett [1]

[1] Sackler Centre for Consciousness Science and Department of Informatics, University of Sussex, Brighton, [2] Coma Science Group, University of Liege, [3] Department of Neurology and Department of Psychiatry, University of Wisconsin, Madison.

Emerging neural theories of consciousness suggest a correlation between a specific type of neural dynamical complexity and the level of consciousness: When awake and aware, causal interactions between brain regions are both integrated (all regions are to a certain extent connected) and differentiated (there is inhomogeneity and variety in the interactions). In support of this, recent work by Casali et al (2013) has shown that Lempel-Ziv complexity correlates strongly with conscious level, when computed on the EEG response to transcranial magnetic stimulation. Here we investigated complexity of spontaneous high-density EEG data during propofol-induced general anaesthesia. We consider three distinct measures: (i) the above-mentioned Lempel-Ziv complexity, which is derived from how compressible the data are; (ii) amplitude coalition entropy, which measures the variability in the constitution of the set of active channels; and (iii) the novel synchrony coalition entropy (SCE), which measures the variability in the constitution of the set of synchronous channels. We explored behaviour

of the measures on the EEG data, analysing broadband and frequency restricted signals, and channel selections taken from either the whole cortex or restricted to certain lobes (i.e. occipital, temporal, parietal or frontal). Channels were selected to be equally spaced, and pre-processing included spatial filtering. On the broadband signal, whether computed across the whole cortex or across any of the individual lobes, all three measures substantially and consistently decreased during anaesthesia. On restricted frequency signals (whole cortex), the same was found for the delta, beta and gamma bands (less consistent changes were found in the alpha and beta bands). Importantly, to show that changes in the measures reflected more than mere spectral changes, we also computed the measures normalised by their values for phase-randomised surrogate data. Results were fully conserved under this control. Results were also robust under a range of choices for the number of channels (between 10 and 100) and segment length (between 2s and 10s). We also performed simulations on Kuramoto oscillator models, on which SCE diverged from the other measures, thus demonstrating that the three measures are together capturing more than one distinct flavour of complexity. In summary, we show that there is a robustly measurable decrease in the complexity of spontaneous EEG during general anaesthesia.

P167 - Microscopic Insight into Human Consciousness

Ivan Sosa [1], Valter Stemberga [1], Ines Strenja Linic [2], Drazen Cuculic [1]

[1] University of Rijeka Medical Faculty; Department of forensic medicine and criminalistics, [2] Rijeka University Clinical Hospital; Neurology Clinic; Neurosonology Laboratory.

BACKGROUND: Koubeissi et al. delivered consciousness into a materialistic realm. What have Fernandez-Espejo and Owen speculated, with a prospect of using functional neuroimaging developments and deep-brain stimulation, has become quite tangible and attainable in form of a small, unilateral area. That location's electrical stimulation reproducibly disrupted consciousness. The same could be achieved by different pathological processes, commonly involving one of the following mechanisms: diffuse hemispheric damage, brain-stem damage or bilateral thalamic damage. Changes in the claustrum would be microscopically visible on post-mortem neurons similar to the changes described in paper of Pulsinelli and Brierley.

HYPOTHESIS: We are apt to microscopically assess claustrum/insula complexes of 15 deceased "minimally conscious" patients. Ability of claustral projection neurons that express the gene encoding the vesicular glutamate transporter (Vglut 2) should help us identify the claustrum since Vglut 2 is considered unambiguous marker of glutamatergic claustral projection neurons on antibody-grounded basis. Neuronal cell death will be assessed at 200× magnification, according to 0-3 scale by estimating the percentage of acidophilic neurons, grade 0 = no damage, grade 0.5 = < 10% acidophilic neurons, grade 1.0 = 10-25% (mild damage), grade 1.5 = 26-45%, grade 2.0 = 46-54% (moderate damage, in most previous observations associated with at least mild), grade 2.5 = 55- 75% and grade 3.0 = > 75% acidophilic neurons (severe damage, edema in most previous observations associated with severe edema and a disrupted, pale neuropil). Control group should comprise 15 counterparts, deceased as traumatic brain injury (TBI) victims presented with: diffuse hemispheric damage (N=7), brain-stem damage or bilateral thalamic damage (N=8).

PURPOSE: Highlighting the detachment of modern consciousness concept from Harvard criteria for equating brain death with human death and later. Study should demonstrate how simple microscopic examination after death could show radiographically invisible changes in order to demonstrate how simple assessment could provide some crucial answers. We hope to be able to appreciate how this simple technique shed a new light on the declaration of death guidelines and whether should those be reconsidered ? Would this influence organ donation and transplantation statistics ?

EMOTION - II

P168 - Awareness and regulation of fear emotions among children

Lubov Akopian [1]

[1] Samara State Academy of Social Sciences and Humanities, [2] Psychology department, [3] Department of Psychology, Developmental and educational psychology department professor, [4] Doctor of Psychological Science.

Emotional intensity and dynamics of life in modern society create high psychological stress in both adults and children. These circumstances are due to changes in the society, increasing demands for intellectual, psycho-emotional and human physical abilities. Children are the least protected in these conditions as their mind is still unstable, vulnerable and susceptible to influence of environment. In connection with this, a growing sense of helplessness and uncertainty in the child's own well-being, causing anxiety and a large number of fears. Conscious emotion regulation is one of the key psychological problems. Connection between consciousness and emotions is investigated in works of Y. Alexandrov, M.E. Sams, P.M. Niedenthal, L.F Barrett, P. Winkielman etc.; basic research of children's fears is presented in works of A. Jersild, F. Holmes; children's fears are considered in works of L. Nemet-Pier, S. Garber, and A. Zaharov etc. Socio-economic instability is reflected in the content of conscious and unconscious fears: social (parents lose their jobs, being poor or homeless etc.), technogenic (wars, terrorism etc). A multi-dimensional complex allows to reveal similarities and differences between realizable (verbal form) and unconscious (drawings content, figurative form) fears. Realizable fears of the surveyed children aged 7-10 years are fears of darkness and animals. Significant part of un verbalized images in drawings is connected with the theme of death and refers to a group of thanatology fears. Fear of animals is noted both in verbal and non-verbal forms. In spectrum of zoophobic fears, the greatest number is associated with dogs; in written explanations children note being afraid not of the dog but of evil dog's look. Depicting animals, children often use real-existing colors (green crocodile, brown bears, yellow lions etc.). However, there are drawings, where animals causing fear, are intentionally drawn in speckled, rainbow colors, as if the child is trying to reassure himself with a non-terrible image of a terrible object (pink and green dog, blue and red lion, blue bear, etc.). Some tricks of unconscious fear control are traced in children's drawings (non-verbal form): transformation of a scary image by converting it into a non-scary one (diminution, prettification); balancing central fear image (before or after drawing) with additional positively colored element (plot); external support objects, help from outside.

P169 - Emotion matters! Effects of emotional prosody on stimulus processing across consciousness states

Christine Blume [1,2], Renata del Giudice [1,2], Malgorzata Wislowska [1], Julia Lechinger [1,2], Dominik Heib [1,2], Daniel Koerner [1], Maria-Teresa Gnjezda [1], Kerstin Hoedlmoser [1,2], Manuel Schabus [1,2]

[1] Laboratory for Sleep, Cognition and Consciousness Research, Department of Psychology, University of Salzburg, Salzburg, Austria, [2] Centre for Cognitive Neuroscience Salzburg (CCNS), University of Salzburg, Salzburg, Austria.

One of the strongest stimuli to automatically catch attention is a person's own name (ON). Auditory presentation of the ON has been shown to evoke electrophysiological markers of attention-orienting that even persist in states of diminished consciousness such as sleep (Perrin et al., 1999). Likewise, the emotional content such as familiarity of voice (del Giudice et al., 2014) or emotional prosody (Wambacq et al., 2004) has been shown to capture attention during wakefulness. Here, we investigated effects of self-relevance (ON vs. unfamiliar name (UN)) and emotional prosody (angry vs. neutral voice (AV and NV)) on cognitive processing of stimuli across different consciousness states (wakefulness, N1/N2 sleep). Since links between theta ERS, alpha ERD and attention and memory processes are well-established (e.g. Klimesch, 1999), we investigated stimulus processing by means of event-related de-/synchronization (ERD/ERS) in the theta (4-7Hz), lower (8-10Hz) and upper alpha (11-12Hz) bands of the EEG. EEG recordings were obtained from 21 healthy individuals while they passively listened to the stimuli during wakefulness and a two hour nap. For data analysis, sleep was scored automatically

according to standard criteria. Following preprocessing, data was segmented, wavelet-transformed (Morlet Complex, $c=8$) and averaged. Subsequently, ERD/ERS was calculated above frontal and parietal electrodes for theta and alpha bands, respectively. ERD/ERS was calculated for four time windows (T1-4) of equal length from 0-800ms relative to stimulus onset with a pre-stimulus baseline from -700 to -100ms. Only theta ERS differed between stimuli in the wake state. Surprisingly, there was no effect of name. However, AV led to stronger ERS in T1 and T2 compared to NV with ERS generally peaking in T2. This suggests that AV engaged more attentional or working memory resources irrespective of the name presented. In N2 sleep the peak response was delayed with ERS to AV and NV peaking in T3/4 and T3, respectively, probably reflecting decreased processing speed. Moreover, the response to AV compared to NV during N2 was longer-lasting, again suggesting that more processing resources were allocated to AV stimuli. In conclusion, results support the notion that emotional prosody does not only draw attention during wakefulness, but also during states of diminished consciousness such as N2 sleep. Research was funded by the Austrian Science Fund FWF (project Y-777 and Doctoral College W1233-G17).

P170 - Gut feelings: investigating the influence of unconscious emotion on metacognitive insight

Darya Frank [1], Geraint Rees [1,2], Micah Allen [1,2]

[1] Institute of Cognitive Neuroscience, University College London, UK [2], The Wellcome Trust Centre for Neuroimaging, University College London, UK.

Metacognition, the ability to think about and evaluate our own states, is uniquely human. Our awareness of internal states, or metacognitive sensitivity, plays an important role in consciousness and sense of self. The objective sensitivity of subjective confidence to actual performance serves as a quantitative measure of metacognition (Fleming & Lau, 2014; *Fro. Hum. Neurosci.*). New advances in signal-theoretic modelling now make it possible to make an unbiased quantification of metacognitive sensitivity (Lau and Maniscalco, 2010; *Science*). While these models provide an objective measure of introspective ability, thus far they have primarily been applied to the study of metacognition as a single serial channel of perceptual meta-representation, in sharp contrast to the phenomenological character of introspection as a multimodal embodied experience. Indeed, the influence of embodied states such as emotion and arousal on perception and cognition is well-established (Park et al, 2014 *Nat. Neurosci.*). However, little is currently known about how such processes impact our metacognitive sensitivity. Here we test the hypothesis that the subliminal presentation of arousing faces will improve metacognitive performance by increasing the subjective weight of highly variable stimuli, using signal theoretic and physiological measures. To do so, we used backwards-masked high arousal, negative valence facial expressions that were presented subliminally to elicit an unconscious emotional response. Participants performed a left/right global motion psychophysical discrimination task, and rated their subjective confidence on each trial. During the experiment pupillometry, heart rate and facial EMG were also recorded as psychophysiological measures. Signal-detection measures of insight were estimated using the hierarchical meta- d' approach, yielding measures of relative insight (M-Difference) and metacognitive bias (M-Criterion). We predicted that high-arousal primes would evoke greater metacognitive liberalism and higher confidence, improving introspective sensitivity. We further modeled the effect of prime-evoked arousal on the observed shift in metacognitive behavior, in order to demonstrate the influence of bodily state on introspective awareness. Preliminary results suggest that unconscious emotion stimuli increase metacognitive sensitivity, in which salient information non-linearly weights introspective judgements through both exteroceptive and interoceptive channels.

P172 - Dissociating unconscious emotion through differential physiological responses

Gina M. Grimshaw [1], Michael Tooley [1], Angus Chapman [1], David Carmel [2]

[1] Victoria University of Wellington, [2] University of Edinburgh.

Emotional stimuli can evoke physiological responses even when they are suppressed from awareness. However, whether unconscious responses are coordinated across multiple systems or are confined to specific pathways remains unclear. Here, we investigated this issue by simultaneously recording four physiological responses to a sudden loud noise while emotional images were viewed with and without awareness. Different physiological systems are sensitive to different aspects of emotional processing. Skin conductance response (which reflects sympathetic activation) and heart rate deceleration (which reflects attentional engagement) are both potentiated when viewing high arousal images, whether positive or negative. However, a loud noise burst produces two reflexes that are modulated by the valence of a co-occurring image. Startle eye-blink responses reflect defensive responding, and are potentiated by negative (compared to neutral or positive) images. Postauricular reflexes reflect appetitive responding, and are potentiated by positive (compared to neutral or negative) images. Would all of these systems show similar emotional modulation to images presented outside awareness? Participants viewed high arousal positive (erotic) or negative (mutilation) images, or their pixel-scrambled versions; arousal was matched across valences. Images were presented monocularly, and either suppressed from awareness by continuous flash suppression (a high-contrast dynamic image presented to the other eye; unaware condition) or viewed without suppression (aware condition). A loud white noise burst was presented 3.5-4.5 seconds after image onset, producing a startle response. To assess awareness, after each trial participants made a forced-choice categorisation to indicate whether an intact or scrambled image had been shown, followed by a confidence rating. For the unaware condition, only trials in which participants reported low confidence were analysed. Certain physiological responses – the startle eye-blink reflex and heart rate deceleration – were only modulated by consciously viewed images. However, skin conductance responses and postauricular reflexes showed typical emotion modulation regardless of awareness. These qualitative dissociations between simultaneously-recorded responses suggest that while some physiological pathways can be activated without awareness of an emotional signal, a coordinated emotional response across multiple systems may require conscious awareness.

P173 - Exploring transformations in emotion in depression using mixed methods: The value of incorporating the subjective viewpoint

Emily Hammond [1]

[1] University of Exeter

Jack and Roepstorff (2002) have argued that failure to incorporate subjective, self-report data into experimental research is a wasted opportunity to obtain the fullest possible understanding of the phenomenon under investigation. Nevertheless, experimental work in psychology and neuroscience frequently foregoes this opportunity. This paper contends that subjective data can enrich the scientific study of consciousness in at least two ways: by identifying fresh targets for experimental research, and by elaborating on, or suggesting more nuanced interpretations of, quantitative-experimental data (as in, for example, Francisco Varela's (1996) neurophenomenology). This argument will be reinforced using data from a qualitative case study exploring transformations in the subjective experience of emotion, specifically sadness, following Mindfulness-Based Cognitive Therapy (MBCT; Segal et al., 2013) for recurrent depression. Findings from this study illustrate how investigating the phenomenology of sadness both as an emotion in the moment and a filter through which life is encountered can refine understanding of theoretical mechanisms of therapeutic effect and uncover novel questions for experimental research on MBCT and emotion. This completed study serves as a foundation for doctoral research examining the potential for synergy between first- and third person approaches to investigating affective consciousness. The final section of the paper will describe how insights derived from the case study will be applied in neurophenomenological work (scheduled for late 2015) aiming to integrate

psychophysiological indices of affect with fine-grained accounts of direct experience gathered using the elicitation interview (e.g., Petitmengin, 2006).

Jack, A. I. & Roepstorff, A. (2002). Introspection and cognitive brain-mapping: from stimulus-response to script-report. *Trends in Cognitive Sciences*, 6, 333-339.

Petitmengin, C. (2006). Describing one's subjective experience in the second person: An interview method for the science of consciousness. *Phenomenology and the Cognitive Sciences*, 5, 229-269.

Segal, Z.V., Williams, J.M.G. and Teasdale, J.D. (2013). *Mindfulness-Based Cognitive Therapy for Depression: Second Edition*. The Guilford Press: New York, NY.

Smith, J.A., Flowers, P. and Larkin, M. (2009). *Interpretative Phenomenological Analysis: Theory, Method and Research*. Sage: London.

Varela, F. J. (1996). Neurophenomenology. *Journal of Consciousness Studies*, 3, 33.

P174 - Causal Structures and Insightful Psychopaths

Nobel Truong [1]

[1] University of California, Berkeley.

Traditionally, the way in which we come to understand the mental causal structure of others is thought to be closely related to our own ability to empathize emotionally with others. The motivation behind this is the idea that how we arrive at our predictions regarding the actions of others is, to a certain extent, a reflection of ourselves and our own emotional responses. However, in the case of insightful psychopaths, one could still have a solid grasp on the mental causal structures of others without mobilizing one's emotions. In this paper, I will discuss how psychopaths can engage empathetically with others without mobilizing their emotions and argue for what this might suggest about our understanding of the mental causal structures of others in general.

P175 - Subcortical routes involved in the unconscious processing of emotional visual information

Petra Vetter [1, 2], Marco Tamietto [3], David Carmel [4] & Patrik Vuilleumier [1]

[1] University of Geneva, Switzerland, [2] New York University, USA, [3] University of Torino, Italy, [4] University of Edinburgh, UK.

Here we studied the cortical and subcortical pathways involved in conscious and unconscious processing of emotional visual information in the human brain. We used dog images as visual stimuli and employed classical fear conditioning to associate emotional valence to one dog image (CS+) but not to another (CS-). We suppressed stimuli from consciousness using continuous flash suppression or displayed them clearly visible. In order to tap into different subcortical processing routes, we furthermore filtered images for spatial frequency and displayed them either in grey scale or in calibrated purple, a wavelength to which the superior colliculus is insensitive due to lack of S-cone input. Behavioural results show that when stimuli are successfully suppressed from consciousness, subjects are nevertheless able to guess the location of fear-conditioned stimuli significantly above chance and better than unconditioned stimuli. However, this was only true when fear-conditioned stimuli were displayed in low spatial frequency and in purple. These results suggest that emotional visual information is processed in the absence of consciousness and that specific subcortical routes are involved in this processing.

P176 - Seeing invisible fearful bodies: A role of the intraparietal sulcus in non-conscious body processing

Minye Zhan [1], Beatrice de Gelder [1]

[1] Department of Cognitive Neuroscience, Faculty of Psychology and Neuroscience, Maastricht University, the Netherlands.

Studies have shown that facial expressions are being processed outside consciousness, but the non-conscious processing of the bodily expressions are less studied. In a previous behavioral experiment we used breaking from continuous flash suppression (CFS) to investigate the relation between different bodily expression and awareness (Zhan, Hortenius & de Gelder, submitted). The study here used the CFS paradigm in combination with fMRI (participant number=7), and examined the neural correlates for non-conscious fearful body processing. In this slow event-related experiment, upright or inverted fearful bodily expressions were projected to one eye of the participant, and a dynamic color Mondrian noise pattern flashing at 10 Hz was projected to the other eye. The stimulus was rendered invisible by this presentation, or rendered visible by also overlaying the same stimulus to the noise pattern. Regions of interest (ROIs) were defined in a separate functional localizer with faces, bodies, houses, tools, words. Extrastriate body area (EBA), fusiform body area (FBA) ROIs were determined by the contrast bodies>houses, and three spherical ROIs were determined with the contrast tools>baseline, in the anterior, middle and posterior intraparietal sulcus (IPS) contralateral to the participants' handedness. We found that a significant interaction between body orientation and visibility in the posterior IPS ROI, whilst the bilateral EBA, FBA, and anterior IPS ROIs only showed higher activations for the visible fearful bodies. These results indicated that the dorsal pathway especially the IPS might play an important role in non-conscious processing of the fearful bodily expression. We also showed that the CFS paradigm can provide valuable insights to the non-conscious processing of bodily emotions.

METACOGNITION

P177 - Minimal requirements for valid measures of metacognition: causal and statistical considerations

Agata Blaut [1], Borysaw Paulewicz [2], Aleksandra Gronostaj [3]

[1] Affiliation Institute of Psychology, Jagiellonian University, [2] Affiliation University of Social Sciences and Humanities, Campus in Katowice, [3] Affiliation Faculty of Pedagogy, Pedagogical University of Cracow.

Limitations of popular measures of metacognition are analyzed by means of causal graphical models. It is shown that because of confounding causal pathways valid measurements of metacognition are a rare breed. One theoretical measure - meta d-prime - and one atheoretical measure - logistic regression slope - are examined in some detail within this general framework. It is found that the logistic regression based measure is quite flexible but it does not provide a valid estimate of metacognitive sensitivity in many typical experimental settings. The validity of meta d-prime is even more limited because this measure captures only one relevant causal pathway (i.e., from the stimulus to the metacognitive process) and because it assumes that the subject makes use of the information provided by the conditional distributions that are rarely, if ever, available.

P178 - Confident here, confident there: transfer of confidence between unrelated visual tasks

Andrey Chetverikov [1,2]

[1] Department of Psychology, Saint Petersburg State University, Saint Petersburg, Russia, [2] Laboratory for Cognitive Studies, RANEPa, Moscow, Russia.

People often do several tasks in parallel. It is well known that performance is decreased when task-switching is necessary (Monsell, 2003), but evidence on metacognitive monitoring in task-switching is scarce. Recently, several authors reported that errors in tasks such as perceptual identification, visual search, and Go/No-Go, may evoke negative affect even without external feedback (Aarts, De Houwer, & Pourtois, 2013; Chetverikov, Jóhannesson, & Kristjánsson, 2014). Moreover, error-related affect correlates with confidence ratings (Chetverikov & Filippova, 2014). I hypothesized that people engaged in task-switching may misattribute affective reactions originating from answers in one task to answers in another, leading to a bias in confidence ratings. Two experiments tested this hypothesis using two alternating visual tasks. In the first task observers estimated the average orientation of a set of lines. The second task was either a contour discrimination (Experiment 1) or a change detection task (Experiment 2). After each trial observers provided their confidence ratings using a five-point scale. I analyzed how answer accuracy and confidence on a given trial in one task influence confidence in another task on the N+1 trial as compared to N-1 trial. Experiment 1 demonstrated strong correlations between the confidence ratings in the two tasks. More importantly, confidence ratings in the “lines” task were higher following correct answers in “contours” tasks than after errors. The effect of the accuracy in “lines” task on the confidence in “contours” task was not significant. Experiment 2 tested the effect of graded versus dichotomous task on between-task transfer of confidence. One group reported presence or absence of changes while another judged how many changes occurred. Preliminary result indicate that observers in “dichotomous” condition show the transfer of confidence from change detection to “lines” task while those in “graded” condition do not. In sum, when observers have to switch between multiple tasks, their confidence ratings in “graded” tasks will be biased by their accuracy in all-or-none tasks. The implications of these findings for the theories of confidence and visual awareness are discussed.

P179 - The role of conscious awareness in performance monitoring and decision-making

Camile Maria Costa Correa [1], Samuel Noorman [1], Jun Jiang [1], Michael X Cohen [1], Simon van Gaal [1]

[1] University of Amsterdam.

Monitoring actions based on feedback is critical to adaptive decision-making. The conscious expectation of rewards can improve this learning process, but it is also known that reward pursuit can occur outside of awareness (Custer and Aarts, 2010). In the lab, consciously presented feedback elicits a typical sequence of cortical event-related potentials (ERPs): the feedback-related negativity (FRN) is a medial frontal cortex ERP that distinguishes positive from negative feedback, a “fast alarm” signal reflecting the incoming evidence, which might then accumulate to give rise to the late posterior positivity (P3b). This slower component likely represents a “subjective evidence signal” which might predict behavioral adaptation (Ullsperger et al., 2014). Here we present an EEG experiment designed to test whether unconscious reward processing plays a role in modulating performance monitoring and, if so, what are its neural features. Subjects performed a probabilistic reinforcement learning task in which we manipulated the probability of high and low value feedback to each of the two possible response options. The outcome of each decision could either be a reward (50 cent coin) or punishment (1 cent coin) and crucially, this feedback was sometimes masked from awareness (invisible coin) or presented fully consciously (visible coin), mixed within blocks. Behaviorally, subjects adapted their decision-making strategy to maximize rewards. They switched more after punishments than rewards, irrespective of the awareness of the coin. As expected, ERP analyses revealed that punishments elicited a larger medial frontal FRN compared to rewards, for both coin visibilities. This punishment-related amplitude was more negative after improbable conditions, showing that there is also unconscious violation of expectation.

On the other hand, P3b was strongly modulated by feedback awareness: it was present for visible punishments (compared to rewards) but it was fully abolished after invisible punishments. These results suggest that sensory feedback can accumulate to frontal cortex and trigger a fast, but unconscious, alarm signal that the decision was worse than expected. However, visible feedback uniquely elicits a P3b component, which may reflect neural processes that drive future decisions and are uniquely associated with conscious awareness of the decision outcome.

P180 - Sensory variance, gain control, and metacognitive salience - a predictive coding approach to self-awareness

James C. Glen [1], Geraint Rees [2], Micah Allen [1,2]

[1] Institute of Cognitive Neuroscience, University College London, [2] The Wellcome Trust Centre for Neuroimaging, University College London.

Metacognition is the introspection and assessment of one's own internal states and incorporates an individual's ability to accurately evaluate their own decisions through processes such as error monitoring (Yeung & Summerfield, 2012). The accuracy of this self-awareness is known as metacognitive sensitivity and is related closely to consciousness. The relationship between subjective ratings of confidence and performance on perceptual tasks has been shown to act as a reliable measure of metacognition (Fleming & Lau, 2014). Variance conveys important information about signal quality and plays a critical role in perceptual decision making and inference (Brown & Friston, 2011). In the human brain, the anterior cingulate (ACC) and insula cortices have been shown to encode uncertainty, error monitoring and variance across a variety of decisions and are also associated with the processing of visceral or 'gut' feelings. Critchley et al. (2005) have highlighted the importance of the ACC as an interface between physiological arousal signals and error monitoring. Despite this, as of yet no study has investigated the connection between stimulus variance, arousal, and metacognitive awareness. Here we tested the hypothesis that environmental variance evokes salient arousal signals in the parasympathetic pathway to influence upstream metacognitive decision making. We adapted a random-dot kinetogram (RDK) paradigm such that there were two different levels of signal variance. Subjects then performed a simple two-alternative forced choice left-right motion discrimination task followed by a 4-point confidence rating. Accuracy thresholds for participants across both levels of variance were converged to 71% using a 2-up 1-down staircasing procedure. Pupillometric measures were acquired concurrently as an index of physiological arousal, the efficacy of which has been well established (Bradley et al., 2008). Preliminary findings presented in the context of a signal detection theoretic framework demonstrated a consistent and significant effect of variance on the meta-criterion level with more variable stimuli resulting in a more conservative type-II criterion. Additionally, an effect of variance on pupil diameter was observed, suggesting that stimulus variance acts as a salient cue to non-linearly weight self-awareness. These results are interpreted in light of embodied predictive coding.

P181 - Does cardiac activity following perceptual decision increase accuracy of metacognitive judgments in a near-threshold visual perception ?

Marta Łukowska [1], Michał Wierzchoń [1]

[1] Consciousness Lab, Institute of Psychology, Jagiellonian University, Cracow, Poland.

Recent studies revealed that in the near-threshold visual perception accuracy of metacognitive judgment (type 2 decision) is higher when probed after a perceptual (type 1) decision comparing to the accuracy of metacognitive judgment formulated before the decision. This suggests that evidence accumulation process may continue after perceptual decision is made and that the decision serves as an additional source of information, influencing accuracy of metacognitive judgment. A reason why a decision may serve as an additional source of information is autonomous nervous system (ANS) activity following a perceptual decision. Classical studies investigating ANS response to erroneous performance found error-related cardiac deceleration, pupil dilation and changes in galvanic skin response. So, we propose that evidence accumulation process preceding metacognitive judgment takes into account the ANS activity following erroneous perceptual (type 1) decision. Moreover, we argue that it is mediated by

interoceptive awareness (IA; i.e. awareness of an internal body states). Namely, the higher IA, the better error-related ANS activity monitoring and, as a consequence, the higher metacognitive judgment accuracy. The poster will present results of a study aimed to verify the abovementioned hypotheses. In the study, we use near-threshold visual identification task – we very briefly (16ms, 32ms, 64ms, 80ms) present Gabor patches and ask participants to make a decision (type 1) whether a stimulus is tilted right or left. Then, we ask them to judge their confidence (type 2 decision) – i.e. formulate metacognitive judgment. Crucially, we measure cardiac activity using electrocardiogram (ECG) to detect phasic cardiac activity following perceptual (type 1) decision. Additionally, a battery of heart-beat awareness measures (i.e. cardio-visual and cardio-auditory simultaneity judgment task, heart-beat counting task) is administered to assess an interoceptive awareness individual level. Firstly, we hypothesize that deceleration following perceptual decision is more profound after erroneous comparing to correct decision. Secondly, we expect that a deceleration is greater in metacognitively correct erroneous trials comparing to metacognitively incorrect erroneous trials. Finally, we predict that heartbeat awareness mediates the relation between deceleration depth and metacognitive accuracy. Currently data are being analyzed and results are going to be presented during ASSC 19.

P182 - Post-decision wagering reveals both perceptual confidence and error detection awareness

Caio Moreira [1], Max Rollwage [1], Kristin Kaduk [1], Prof. Dr. Melanie Wilke [1,2], Dr. Igor Kagan [1]

[1] Decision and Awareness Group, Cognitive Neuroscience Laboratory, German Primate Center, Goettingen, Germany [2] Department of Cognitive Neurology, Universitätsmedizin Goettingen, Goettingen, Germany.

Humans rely on knowledge about their own cognitive processing (i.e. metacognition) to evaluate decisions and plan future actions (Fleming & Lau 2014). Confidence rating has been used to study metacognition (Fleming et al. 2010). Alternatively, post-decision wagering (PDW) has been proposed as a more motivating and intuitive confidence measure (Persaud et al. 2007). Error detection also occurs after decisions, influencing confidence evaluation (Yeung & Summerfield 2012). The interaction between these processes is not fully understood, and they might share a neural mechanism (Boldt & Yeung 2015). Here we used graded PDW to assess the association of error detection and confidence evaluation, showing that this association was linked to metacognitive efficiency. Eighteen subjects performed a perceptual decision (delayed match-to-sample) with 5 difficulty levels (Type 1 task) under response time pressure. In each trial, six wagers were presented after decision (Type 2 task). According to Signal Detection Theory, sensitivity was calculated for Type 1 (d') and Type 2 (meta- d') tasks. The ratio between meta- d'/d' was used as index of metacognitive efficiency and as indicator for post-decision evidence accumulation (Maniscalco & Lau 2012). Additionally metacognitive sensitivity was calculated for each wager (wager-specific d'). We postulated that the presence of both confidence evaluation and error detection will be manifested as “U-shape” function of wager-specific d' (high d' for both lowest and highest wagers), while a monotonic increasing function will be indicative of only graded confidence. To estimate the similarity to the postulated U-shape, we correlated wager-specific d' and ideal U-shape (U-index). Subjects' performance in the Type 1 task varied (51-88%) as function of perceptual difficulty, which also correlated with mean wager. Most subjects (13/18) had higher meta- d' than d' suggesting continuing accumulation of evidence after the decision. In most subjects, the wager-specific d' was a graded function. The median U-index was 0.50 across subjects, indicating presence of error detection in addition to confidence evaluation. Most importantly, U-index was correlated with the ratio of meta- d'/d' ($r=0.61$, $p=0.008$), demonstrating the link between error detection and metacognitive efficiency. These data show that PDW engages error detection and confidence evaluation, lending support to the notion that both processes contribute to metacognitive ability.

P183 - Metacognitive experiences in subliminal conflict tasks: where do subjective experiences of difficulty originate from ?

Laurence Questienne [1,2,3] , Anne Atas [1,2,4] , Kobe Desender [5] , Wim Gevers [1,2,3]

[1] Center for Research in Cognition and Neurosciences (CRCN), Université Libre de Bruxelles, Belgium. , [2] ULB Neuroscience Institute (UNI), Université Libre de Bruxelles, Belgium, [3] Action Bias & Control Group (AB&C), Bruxelles, Belgium, [4] Cognition and Computation Group (CO3), Bruxelles, Belgium, [5] Universiteit Brussel (VUB), Brussels, Belgium.

In conflict tasks, performance is typically inferior when participants are confronted with response conflict (i.e., the congruency effect). Recently, a congruency effect was also observed in subjective judgments of difficulty, showing that participants have subjective experiences associated with these response conflicts. However, it remains unclear whether these subjective judgments originate from. They could be based on the visual awareness of the stimulus conflict itself, or on general motor performance, or on the level of response conflict (e.g., I was slower and/or both responses were activated). We studied these possible sources of the subjective judgment by asking participants either to judge their urge to err or to give their impression of conflict between the prime and the target in a masked priming task. To dissociate conflict from motor performance, we manipulated the mask-target interval. Usually, with short intervals, incongruent trials are slower than congruent trials (i.e., PCE), but, as the interval increases, congruent trials become slower than incongruent trials (i.e., NCE). Even though primes were presented below the awareness threshold, the results demonstrated that participants had intact metacognitive performance, showing both a PCE and an NCE in their subjective judgments. Moreover, participants' judgments of urge to err and their impression of conflict could be dissociated. The urge to err is related to general motor performance and more specifically to motor conflict, and the feeling of conflict to a conflict at the perceptual level. Our results show that subjective judgments of difficulty are highly dependent on the source of information that is targeted.

P184 - Self-knowledge dim-out: Stress impairs metacognitive accuracy

Gabriel Reyes [1, 2], Jaime R. Silva [3], Karina Jaramillo [3], Lucio Rehbein [4], Jérôme Sackur [1,5]

[1] Laboratoire de Sciences Cognitives et Psycholinguistique (ENS, CNRS, EHESS), PSL Research University, Paris, France, [2] Escuela de Psicología, Universidad Austral de Chile, Valdivia, Chile, [3] - Centro de Apego y Regulación Emocional, Universidad del Desarrollo, Santiago, Chile, [4] - Facultad de Psicología, Universidad de La Frontera, Temuco, Chile, [5] - Institut Universitaire de France, Paris, France.

Modulation of frontal lobes activity is believed to be an important pathway through which the hypothalamic-pituitary-adrenal (HPA) axis stress response impacts cognitive and emotional functioning. Here, we investigate the effects of stress on metacognition, the ability to monitor and control one's own cognition. As the frontal lobes have been shown to play a critical role in metacognition, we predicted that under activation of the HPA axis, participants should be less accurate in the assessment of their own performances in a perceptual decision task, irrespective of the effect of stress on the first order perceptual decision itself. To test this prediction, we constituted three groups of high, medium and low stress responders based on cortisol concentration in saliva in response to a standardized psycho-social stress challenge (the Trier Social Stress Test, TSST). We then assessed the accuracy of participants' confidence judgments in a visual discrimination task. As predicted, we found that high biological reactivity to stress correlates with lower sensitivity in metacognition. In sum, participants under stress know less when they know and when they do not know.

P185 - I was so sure! Metacognitive judgment predicts memory performance better when given after than before a decision

Marta Siedlecka [1], Borysław Paulewicz [2], Michał Wierchoń [1]

[1] Consciousness Lab, Institute of Psychology, Jagiellonian University, Krakow, Poland, [2] Warsaw School of Social Science and Humanities, Faculty in Katowice, Poland.

When finding out about being wrong we sometimes disappointedly think: “But I was so sure!” We remember being certain that we would give the right answer or make the correct choice. But are metacognitive judgments as accurate about future as they are about past task performance? Although both types of judgments have been studied extensively in the field of memory, their accuracy has not been directly compared within the same task. Here we present the results of two experiments aiming to investigate the differences in prospective and retrospective metacognition accuracy (measured with a confidence rating scale) in memory task. In Experiment 1 participants were asked to remember lists of words and then to recognize a word previously presented either before or after assessing their confidence in correct recognition. In Experiment 2 participants worked on anagrams and were asked to decide whether a presented word was the solution, either before or after determining their confidence in the right decision. The results of both experiments showed that although task performance accuracy correlated with confidence ratings in both conditions, this relationship was weaker when metacognition was assessed before the recognition/solution decision. We interpret these data in the context of theories explaining metacognitive judgments in terms of evidence accumulation and post-decisional processing but also on the ground of the hierarchical theories of consciousness.

MODELS & THEORIES OF CONSCIOUSNESS - I

P186 - Structural constraints and information flow in the brain: a TMS/EEG-DTI study

Amico Enrico [1,2], Bodart Olivier [1], Marinazzo Daniele [2], Laureys Steven [1]

[1] Coma Science Group, Cyclotron Research Centre, University of Liège, Liège, Belgium, [2] Faculty of Psychology and Educational Sciences, Department of Data Analysis, Ghent University, Ghent, Belgium.

Introduction - Transcranial magnetic stimulation (TMS) has been used for more than 20 years to investigate connectivity in the human cortex. By combining TMS with electroencephalography (TMS/EEG), one can stimulate any cortical area and measure the effects produced by this perturbation, both in health and disease. In this study we investigated changes of information flow in the brain after TMS and its dependence on anatomical constraints (i.e. white matter pathways), by means of multimodal modeling of TMS/EEG reconstructed sources and diffusion tensor imaging (DTI) tractography.

Methods - We used spectrum-weighted adaptive directed transfer function (swADTF) [1], to investigate the time varying causal relation between time courses of AAL-averaged TMS/EEG sources at a predefined frequency band. We computed swADTF in 3 frequency bands (alpha, beta, beta2/gamma), defined as in [2]. We investigated significant changes in the causal flow between brain regions by splitting the swADTF dynamics in 3 different non overlapping windows of 200 ms: pre (i.e. baseline), during and post TMS. For each frequency band we obtained 3 different connectivity matrices, which gave us a “snapshot” of the information flow pre, during and post TMS. We then defined the out-degree for each node, as the number of outgoing edges from that node, i.e. the sum of non-zero entries in the connectivity matrix, for a specific frequency band and time window.

Results showed that, independently from the frequency band or from the stimulation site, a deviation from the baseline behavior is evident after TMS pulse. The network recovers its quasi-stable configuration after about 300 ms.

Conclusions - In this work we demonstrated how brain reaction to TMS, even though highly chaotic and non-linear, is nonetheless constrained by its structure, at different spatial and temporal scales. Our results shed new light on the structure-function relationship in the TMS-perturbed brain network, and on its complex dynamics.

- 1) M. Rosanova, A. Casali, V. Bellina, F. Resta, M. Mariotti, M. Massimini, Natural frequencies of human corticothalamic circuits, *The Journal of Neuroscience* 29 (24) (2009) 7679-7685.
- 2) P. Van Mierlo, E. Carrette, H. Hallez, K. Vonck, D. Van Roost, P. Boon, S. Staelens, Accurate epileptogenic focus localization through time-variant functional connectivity analysis of intracranial electroencephalographic signals, *Neuroimage* 56 (3) (2011) 1122-1133.

P187 - The perspectives of consciousness

Alla Choifer [1]

[1] Department of Philosophy, Linguistics, and Theory of Science University of Gothenburg, Sweden.

There are three wellknown ways of studying consciousness: from the first-, second- and third-person perspectives (1pp, 2pp and 3pp). In following these pathways researchers encounter, however, some difficulties. There are two competing, mutually incompatible accounts of the first-person perspective, and there is a seemingly insurmountable obstacle of 'epistemic asymmetry' – the asymmetry of access to an object from the 1pp and the 3pp. Another focal point of dispute is whether the 2pp of social cognition actually delivers any knowledge of other minds. To get some insight into these questions it is important to look closer at the differences between the 1st-, 2nd, and 3rd-person perspectives. The differentiation of these perspectives often relies on a grammatical criterion – the pronouns "I", "You" and "He/She" are used as markers for distinguishing the three perspectives. However, this use of grammatical pronouns is not in any way unproblematic since some significant epistemological differences are not reflected in grammar. By exploring these differences I will present a different understanding of the three perspectives. I suggest seeing the 1pp as a perspective of unreflective immediate experiencing, the 2pp as a perspective of an active engagement with others (not about others), and the 3pp as the only perspective of deliberate reflective investigating of an object. In this view, we do not any longer have two different notions of the first person perspective, the 2pp is not a perspective on the second person and therefore does not by itself deliver any knowledge about others, while the 3pp is the only perspective in which one can attend to another subject, or to oneself, as an object and thereby get knowledge about this object.

P188 - Can Phenomenal and Access Consciousness be clearly divided? A perspective from Gestalt psychology

Yi Hsin Chuang [1], Allen Hough [2]

[1] Graduate Student, Institute of Philosophy of Mind and Cognition, National Yang-Ming University, Taiwan.

Phenomenal consciousness and access consciousness are the two different types of consciousness distinguished by Ned Block in 1995. Block and his advocators believe that it is not only a conceptual or theoretical distinction, but also an empirical one, which means that the two kind of consciousness do have different cognitive framework or mental process in our working mind. In addition to this, they also consist that phenomenal consciousness has a more foodful content that "overflows" access consciousness. Block used practical data in psychology and neuroscience to support his hypothesis, like Sperling experiment or a series test on visual perception and short-term memory by Victor Lamme in Amsterdam. However, I disagree with both of his statement, neither do I think that this distinction can be held conceptually or practically, nor do I assert that phenomenal consciousness is richer than cognitive access. In this paper, I will use some perceptual phenomenon in Gestalt psychology to argue against this distinction, for the explanatory success in human perception and cognitive patterns of Gestalt psychology, I think that we shall view it as a valid and innegligible theory in consciousness research. Gestalt psychology is a theory of mind that brought out in 1890, which emphasizes our cognitive ability of acquire and maintain the meaningful perception of the external world (most in visual perception). The main principle is the whole is other than the sum of the parts, suggesting that the content of perception representation contains not only the objective features, but also our subjective cognition to complete a meaningful and more clearer mental image. If we can accept Gestalt principle, that our perception (phenomenal consciousness) need cognitive reasoning (access consciousness) to complete a whole mental representation, then Block's overflow hypothesis shall be changed. And, the point he made that P-consciousness and A-consciousness can be double dissociated, and outside stimulus will first into our P-consciousness before it goes to A-consciousness should also be revised, for it may ignored the top-down influences that Gestalt principle emphasized.

P189 – Levels of development of a person from the theory of consciousness

Mianiye (Diukarev) Mykhailo [1,2], Olena Tsybenko [1]

[1] Scientific and Practical System of academician (Kharkov, Ukraine), [2] Ph.D International University of Fundamental Studies.

The purpose is to solve one of the most significant tasks of psychology: definition of the concept of the Levels of human development and their basic qualitative characteristics. At present, despite numerous attempts, this problem is not solved yet. The basic questions are definition of the essence of the Levels of human development and their key mechanisms (the approach is similar to computer characteristics – complexity of solved tasks, speed, productivity, etc.), initial description of the basic Levels (from the easiest to the most complicated one: physical work, the organization and management, private world and its modification, work with the information and teaching experience, influence on society), the basic possibilities and rules of application of these key points. The obtained results form the basis of classifications of existing programs (statements) in accordance with the Levels of development, of workings out of long-term curriculums on Formation of the Personality (through the Levels of development). The present results allow assume that the task in view is basically solved, but its final solution and acknowledgement requires the further researches.

P190 - Towards a Top-Down Approach to Unity of Consciousness

Anna Giustina [1,2,3]

[1] Institut Jean Nicod, [2] École des Hautes Études en Sciences Sociales (EHESS), [3] École Normale Supérieure (ENS).

Typically, theorists of unity of consciousness adopt a bottom-up approach: they take for granted that at any one time a subject undergoes a multiplicity of conscious experiences, and that unity of consciousness is due to a special binding relation among them. In this paper I point out some weaknesses of this mainstream account, and sketch an alternative, top-down approach, according to which a subject undergoes one single conscious experience at a time. Bottom-up accounts explain the unity of consciousness by way of a binding relation among a subject's conscious experiences at a time. Any account that posits a relationship calls for a characterisation of the related elements, so bottom-up theorists must define the relation of unity of consciousness. The most natural strategy for doing so is to look for the 'atoms of consciousness', i.e., the ultimate parts of conscious experience—conscious experiences that do not have further conscious experiences as parts. I evaluate two possible candidates for playing the role of atoms of consciousness: minima sensibilia and homogeneous parts. Minima sensibilia are the least intense conscious experiences one can have. They may be defined, by appeal to psychophysics, as the least intense perceptible stimuli, or as the least noticeable differences in sensory experience. Visual homogeneous parts are circumscribed areas of one's visual field that appear homogeneously coloured. Other homogeneous parts are defined in analogy with vision. I argue that both minima sensibilia and homogeneous parts are not easy to individuate, and that a univocal definition of them cannot be provided. A definition of minima sensibilia in terms of external stimulus intensity is inadequate for conscious experiences other than perception, and particularly for cognitive experience. Similarly, an adequate definition of homogeneous part for experiences other than vision is hard to find. Moreover, even the case of vision meets with some difficulties, since there are cases in which there are no homogeneous parts in one's visual field at all. Instead of the bottom-up approach, I propose a top-down approach according to which unity of consciousness is due to a subject's undergoing one single basic conscious experience at a time. As opposed to the bottom-up approach, the top-down one does not need a univocal characterisation of 'consciousness parts.' I conclude that the top-down approach provides a better account of unity of consciousness than the bottom-up.

P191 - Information integration and the spatiotemporal scale of consciousness

Erik P Hoel¹ [1], Larissa Albantakis [1], Giulio Tononi [1]

[1] Department of Psychiatry, University of Wisconsin, Madison, WI, USA.

Causal interactions in complex systems can be analyzed at multiple spatial and temporal scales, from microscopic elements to macroscopic coarse grains. Previous work has shown that causal emergence is possible: that the cause-effect power may peak at a macro rather than micro level (Hoel, Albantakis, & Tononi, 2013). Finding maxima of cause-effect power is also central to Integrated Information Theory (IIT), which aims to show how key properties of consciousness can be measured in physical systems (Oizumi, Albantakis, & Tononi, 2014). To that end, IIT examines the integration and differentiation of the causal structure of a system: the more causally complex a system, the higher its integrated information (Φ). A key prediction of IIT has been that the spatiotemporal scale at which integrated information peaks in the brain will be the spatiotemporal scale of consciousness (Tononi, 2004). This is important because, from the extrinsic perspective, the brain can be analyzed at the level of atoms, molecules, synapses, neurons, minicolumns, and so on; as well as across an equally vast continuum of temporal timescales. Why consciousness occurs at the particular spatiotemporal scale that it does is an unsolved problem in both neuroscience and philosophy of mind (Chalmers, 2014). Using simplified neuronal-like systems, we present the first evidence that integrated information can peak at a macro spatiotemporal level, indicating that IIT could theoretically account for the spatiotemporal scale of consciousness. This was accomplished by measuring integrated information (Φ) at micro and macro levels of simple discrete systems. We show that the reason Φ can be higher at macro levels is because coarse-graining can increase the amount of irreducible constraint that the state of the system places on the system's past and future. Additionally, we determine the distinct causal components that compose Φ (such as the constraint that a state places on the past and future, the size of a system, and how a system partitions). Using these components we identify causal architectures in which a macro level peak of Φ is likely, and argue that this implies a macro level peak of Φ in the cortex.

P192 - Consciousness: individuated information in action

Jakub Jonkisz [1]

[1] University of Bielsko-Biala.

It is surprising to see questions about the meaning of a central term posed alongside questions about its empirical status, yet that has been the case in consciousness studies. Within its theoretical and empirical enquiries, many different meanings associated with consciousness have appeared, leaving the term itself quite vague. Given just this, the formulation of an abstract unifying concept of consciousness – the overriding aim of this research – is an urgent theoretical challenge. With this in mind, it is argued that the phenomenon of consciousness is dually accessible (cognized from the inside and the outside), hierarchically referential (semantically ordered), bodily determined (embedded in the working structures of an organism) and useful in action (pragmatically functional). These four general features result in a broad view, according to which consciousness is a graded rather than an all-or-none phenomenon. But such a conception, despite its significant explanatory advantages, may also generate some counterintuitive consequences and theoretical problems. In most cases graded consciousness is, to a significant degree, extended globally (attached to primitive organisms or artificial systems) and locally (connected to certain lower-level neuronal and bodily processes). For example, according to information integration theory (as introduced recently by Tononi and Koch), even such primitive artificial systems as photodiodes possess miniscule amounts of consciousness. Another major challenge here, then, is to set reasonable and empirically justified limits on how far the range of its possible instantiations can extend. It is subsequently argued that conscious systems are confined globally by the ability to individuate information (individuated information is characterizable biologically as evolutionarily embedded, socially altered and private), whereas local limitations should be determined on the basis of a hypothesis about the action-oriented nature of the processes that select states of consciousness. Using these constraints, an abstract conception of consciousness is arrived at, which, it is claimed, enables aspects of prominent neurocognitive models (e.g. IIT, GW, GNW) to be linked to major

philosophical ideas (e.g. ecological, embodied and enactive conceptions), hopefully contributing to a more unified state of play within consciousness studies itself.

P193 - Perceptual and Contextual Awareness

Joaquin Navajas [1,2], Hernan G Rey [1], Rodrigo Quian Quiroga [1]

[1] Centre for Systems Neuroscience, University of Leicester, UK, [2] Institute of Cognitive Neuroscience, University College London, UK.

In the last decades, vast empirical and theoretical efforts have been yielded to unravel the neural correlates of consciousness (NCCs). However, to date, there is little agreement about the areas, timing, and mechanisms involved in eliciting a conscious percept. We propose that this is partially due to the fact that different studies report the neural correlates of different conscious processes in the brain. As an example, our own work has recently provided dissimilar evidence in terms of modulations by awareness occurring at different times and in different areas: 1) An evoked potential measured from the scalp in the occipito-temporal cortex peaking at ~170 ms that predicts conscious face perception (Navajas et al., J Neurosci, 2013); 2) Single-cell firing at ~300-400 ms of highly-selective neurons in the medial temporal lobe (MTL) appearing only upon conscious recognition (Quian Quiroga et al., PNAS, 2008); and 3) A deflection in the local-field potential (LFP) in the 4-8 Hz band preceding the firing of MTL neurons that is present only in recognized trials (Rey et al., Curr Biol, 2014). To put together these results into a coherent framework, we introduce a distinction between the perceptual awareness of a visual stimulus, associated to a boost in object-selective neural assemblies, and a more elaborate process (contextual awareness) that we argue is reflected in the firing of concept neurons in the MTL, triggering a rich representation of the context, associations, and memories linked to the specific stimulus (Navajas et al., Front Psychol, 2014).

P195 - Naturalizing Phenomenal Presence: Three Conceptual Obstacles

Roger Christan Schriner

The author is an independent scholar.

Some experiences, especially sensations and perceptions, seem phenomenally present in a way that is difficult to define but central to our understanding of consciousness. This paper will clarify the difference between non-phenomenal states and phenomenally present states, by examining the difference between thought and sub-vocal speech. We will then address three conceptual issues that make it hard to see how sensory phenomena could occur within the brain: (1) Why don't sensory experiences seem like neural tissue? One reason for this discrepancy is that introspection detects highly specific aspects of neural activities rather than whole biological units. Therefore conscious experience cannot act as a microscope or a brain scanner, revealing anatomical details such as the shapes of nerve cells or the routes taken by neurotransmitters across synaptic junctions. Although this may seem obvious, the implications of this fact are often overlooked. (2) Why do some mental states seem phenomenally present while others do not? To answer this question we will analyze the relationship between occurrent qualia, our thoughts about qualia, and the words we use to communicate these thoughts. (3) How could neural activities create the compelling impression of "realness" that is such a striking feature of conscious experiences? In dealing with this issue, we must remember that the brain establishes the human sense of reality, what reality is like for us. To underscore this point we will consider the distortion of reality that results from the neurological syndrome known as hemineglect.

PERCEPTUAL CONSCIOUSNESS - III

P196 - Neural mechanisms of spatial visual illusions: voxel-based morphometry (VBM) study

Vadim Axelrod [1,2] , Moshe Bar [1], Geraint Rees [2,3]

[1] The Gonda Multidisciplinary Brain Research Center, Bar Ilan University, Israel, [2] UCL Institute of Cognitive Neuroscience, University College London, UK, [3] Wellcome Trust Centre for Neuroimaging, University College London, UK.

How accurately does our subjective perception reflect the objective physical properties of the outside world? While the accuracy of the perception obviously depends on the type of task, in simple visual tasks (e.g., deciding which of two circles is larger), we are usually accurate. However, in rare cases, such as visual illusions, conscious perception consistently fails to reflect the objective properties. Critically, this case of dissociation between inner perception and external reality provides an exceptional opportunity to study mechanisms of conscious awareness. In the present study, we explored neural mechanisms of well-established spatial visual illusions (e.g., Ebbinghaus, Muller-Lyer, and Ponzo). The study included behavioral evaluation of strength illusionary effects and structural anatomical MRI scanning. By capitalizing on the fact that the strength of the illusionary effects varied among participants, we conducted voxel-based morphometry (VBM), where the amount of grey matter volume was correlated with behavioral scores (i.e., illusion strength). We found that the grey matter volume in the parahippocampal gyrus significantly correlated with the strength of the Ebbinghaus and Muller-Lyer illusions. We suggest that the parahippocampal gyrus, the region known to be responsible for spatial processing, might be responsible for the illusory effects of the Ebbinghaus and Muller-Lyer illusions.

P197 - How Mind handles uncertainty in ambiguous figures

J. Antonio Aznar-Casanova [1,2], Manuel Moreno Sanchez [1], Nelson Torro-Alves [3]

[1] Department of Basic Psychology, University of Barcelona, Spain, [2] Institute for Brain, Cognition and Behaviour (IR3C), Spain, [3] Universidade Federal da Paraíba, João Pessoa, Brazil (UFPB).

It is an important goal of neuroscience to explain how the brain selects one possible interpretation from a bistable stimulus and how it becomes eventually conscious. Previous work has focused on whether this decision occurs in early sensory processes or late cognitive processes. Here we studied how stimulus properties, context, and observer-related factors influence perceptual selection. To this end, we asked 30 participants to make forced choice judgments to an ambiguous stimulus. Two sets of instructions were used to induce either a loose or a strict response criterion, and 17 orientations of a modified version of the duck/rabbit were presented. Participants had to indicate whether the target stimulus was a duck or a rabbit. Data analysis revealed that changes in orientation induced changes in the interpretation of the ambiguous picture. Observers seem to assign probabilistically a category to each stimulus orientation, according to an implicit criterion of typicality. This criterion is mainly stated by the prototype orientation, but also changes depending on the context, prior experience, and observers' biases. We carried out several discriminant analyses to ascertain how ambiguity can be gauged as uncertainty. We promoted three levels of uncertainty: 1) low [orientations around the prototype], 2) medium [orientations in the cut-off between the two interpretations] and 3) high [orientations distant from each prototype]. We found that under lowest uncertainty, observers based their responses almost exclusively on orientation. However, under medium level of uncertainty, observers based their responses preferentially on their prior experience and the context associated to the set of instructions. High levels of uncertainty led observers respond mainly on their personal bias and context. Our results support the idea that identifying an ambiguous figure consists basically in a categorization based on implicit prototypes. The proximity to the prototype expresses response uncertainty, and may be gradually manipulated by the orientation of the figure. The degree of uncertainty of each observer can be measured by calculating the Shannon entropy. Interestingly, the uncertainty values of each observer and contextual factors may be more important to influence the responses than the properties of the ambiguous stimulus per se. Therefore, interactions between sensory-driven and interpretation-driven processes are likely to occur for assigning a category.

P198 - Electrophysiological correlates of individual percepts arising from the bistable face-vase figure

Phoebe Bauer [1], Michael Pitts [1]

[1] Reed College, Portland OR, USA.

Previous EEG studies have presented bistable figures intermittently (interleaved with blank interstimulus intervals) to allow time-locking of ERPs. In the typical intermittent paradigm, subjects are tasked with reporting switches from one percept to another. This allows comparisons between ERPs elicited by the same physical stimulus according to whether perception changed (“reversal”) or stayed the same (“stable”) relative to the immediately preceding trial. Such studies have reported a reversal negativity (RN), from ~200-350ms over posterior electrodes, and a late positive component (LPC) from ~400-600ms over central-parietal electrodes, for reversal compared to stable trials. Surprisingly, previous ERP research on bistable figures has focused exclusively on “reversal vs. stable” contrasts, leaving open the question of how brain activity differs when subjects experience “percept A vs. percept B”. To investigate this, we asked subjects to instead report which percept they experienced on each individual trial. This modification allowed for analysis of both “percept A vs. B” and “reversal vs. stable”. To optimize detection of ERP differences between percepts, we utilized Rubin’s face-vase, and focused the analysis on the face-specific N170 component. To ensure that any observed amplitude effects in the N170 time-frame were indeed face-specific, a control stimulus was created with the same figure-ground ambiguity and central/peripheral layout as the face-vase but with smoothed contours that removed all identifiable facial features. For both the face-vase and the control stimulus we replicated the previously reported RN and LPC effects. More importantly, when ERPs were compared between face and vase percept trials, a larger N170 was observed over bilateral occipital electrodes for face percepts. This N170 difference was absent when ERPs were compared across spatially matched figure-ground percepts in the control stimulus. This pattern of results rules out the possibility that the N170 difference was due to differences in spatial attention (central vs. peripheral) or to differences in attending to two objects vs. one. While the current paradigm cannot determine whether the N170 difference reflects attention to or consciousness of faces, our results demonstrate a close link between the N170 and conscious face perception.

P199 - Breakthrough Percepts of Salient Faces – (Sub)liminal Salience Search and EEG Deception Detection on the Fringe of Awareness

Howard Bowman [1,2], Abdulmajeed Alsufyani [2], Marco Filetti [3], Omid Hajilou [2], Alexia Zoumpoulaki [2]

[1] School of Psychology, University of Birmingham, [2] Centre for Cognitive Neuroscience & Cognitive Systems, School of Computing, University of Kent at Canterbury, [3] Helsinki Institute for Information Technology, Aalto University.

We use the term (Sub)liminal Salience Search (SSS) to describe humans' extraordinary capacity to “preconsciously locate stimuli that are salient to them [2], with the locating being in time as well as space. A particularly compelling demonstration is Rapid Serial Visual Presentation (RSVP), in which the vast majority of stimuli presented are not perceived sufficiently to encode into working memory (hence the term (sub)liminal), but ones that are salient breakthrough into consciousness and are encoded (hence the term search). Importantly, although we may experience RSVP as a jumble of “overlaid” visual stimuli, perceptual processing is in fact, highly selective, as indicated by high identification [4] and detection [2] accuracies. In addition, the P3 is an EEG correlate of perceptual breakthrough in RSVP, providing a means to determine what a participant's brain finds salient. We will discuss how theories, such as the Simultaneous Type/ Serial Token model [1], explain SSS, and how it can be used in deception detection [2]. We will review our demonstration that this Fringe-P3 identity detector is resilient against countermeasures, e.g. artificially elevating the response to the control stimulus [3]. Then we will present new experimental findings, which show that famous faces presented in RSVP break into awareness and that such breakthrough can be detected with EEG on a per-individual basis. This suggests that our Fringe-P3 method can be applied across a variety of face-related forensics settings, e.g. face composite systems, line-ups, demonstrating familiarity to compatriots. Importantly, the effectiveness of this

deception detector is intimately tied to the limits of the human capacity to (sub)liminally search, a point we will expand upon.

[1] Bowman, H & Wyble, B (2007) The Simultaneous Type, Serial Token Model of Temporal Attention and Working Memory. *Psychological Review*, 114 (1). pp.38-70.

[2] Bowman, H; Filetti, M; et al (2013) Subliminal Salience Search Illustrated: EEG Identity and Deception Detection on the Fringe of Awareness. *PLoS ONE*, 8 (1). pp. 1-21.

[3] Bowman, H; Filetti, M; et al (2014) Countering Countermeasures: Detecting Identity Lies by Detecting Conscious Breakthrough. *PLoS ONE*, 9 (3). pp. 1-17.

[4] Craston, P; Wyble, B; Chennu, S; & Bowman, H (2009) The attentional blink reveals serial working memory encoding: Evidence from virtual and human event-related potentials. *Journal of Cognitive Neuroscience*, 21 (3). pp. 550-566.

P200 - The role of noradrenaline in visual awareness: a pharmacological fMRI study

Hagar Gelbard-Sagiv [1*], Efrat Magidov [1*], Haggai Sharon [1,2,3], Talma Hendler [1,2,4], Yuval Nir [1]

*** Equal contribution**

[1] Sackler School of Medicine and Sagol School of Neuroscience, Tel Aviv University, Tel Aviv, Israel, [2] Functional Brain Center, Wohl Institute of Advanced Imaging, Tel Aviv Sourasky Medical Center, Tel Aviv, Israel, [3] Department of Anesthesiology, Critical Care and Pain Medicine, Tel Aviv Sourasky Medical Center, Tel Aviv, Israel, [4] School of Psychological Sciences, Tel Aviv University, Tel Aviv, Israel.

How are external events incorporated into our subjective reality? Several lines of evidence suggest that the locus coeruleus-noradrenaline (LC-NE) system may play a key facilitating role in this process: during sleep and anaesthesia, when external events typically fail to elicit conscious percepts, LC-NE activity is markedly reduced or entirely silent and its activity is reinstated with recovery of conscious perception upon arousal. During wakefulness, LC-NE activity is implicated in orienting towards behaviourally relevant stimuli and correlates with EEG markers of conscious perception like the P300. While such findings offer correlative evidence for the relationship between LC-NE activity and perception, causal evidence remains absent. To this end, we pharmacologically manipulated NE levels in healthy volunteers, and tested the causal effects of up- or down-regulation of NE on visual awareness as well as on spontaneous and visually-evoked brain activity as measured with blood oxygenation level-dependent (BOLD) functional MRI. Six participants received Clonidine (α_2 adrenergic agonist; 0.15mg) which reduces NE levels, Reboxetine (NE reuptake inhibitor; 4mg) which increases NE levels, and placebo, in three double-blind, counterbalanced sessions conducted a week apart. Functional MRI scanning during visual stimulation and during rest was performed two hours after drug administration. In the visual task, participants categorized images of objects and patterns presented at 4%, 10% and 100% contrast levels. We found that NE levels affected accuracy and reaction times for the liminal condition (4% contrast) as well as the spread of BOLD responses from low-level to high-level visual regions. In addition, during rest with eyes open, functional connectivity changed as a function of NE level. Our preliminary results suggest that reduced NE activity increases perceptual threshold and gives rise to impoverished neural responses that are restricted to low-level visual areas, whereas enhanced NE activity aids perceptual incorporation and effectively drives neuronal activity in high-order visual areas. Taken together our results hint that NE might play an enabling causal role in visual awareness. Future work will substantiate these results, examine whether they generalize to other sensory modalities, and establish whether effects are specific for NE signalling or whether similar processes are brought about by other neurochemical systems.

P201 - Detection vs recognition: uncovering the role of spontaneous alpha oscillations in visual conscious processing

Luca Iemi [1,2], Sébastien Crouzet [1], Maximilien Chaumon [2], Niko Busch [1,2]

[1] Institute of Medical Psychology Charité-Universitätsmedizin Berlin Germany, [2] Berlin School of Mind and Brain Humboldt-Universität zu Berlin Germany.

Spontaneous alpha oscillations are traditionally considered to impair visual perception: high alpha power before stimulus presentation is correlated with failures in subsequent visual detection (e.g. Ergenoglu et al., 2004). Despite this evidence, some published studies (e.g. Hanslmayr et al., 2007) as well as recent experiments in our lab failed to observe this effect, suggesting that the mechanisms behind it may be more elusive than previously thought. This study aimed to compare different experimental paradigms to investigate what perceptual mechanism is affected by alpha oscillations. We recorded ongoing brain activity with electroencephalography (EEG) while human observers had to detect either the presence (yes/no) or the spatial location (left/right) of a briefly-presented Gabor patch, or to discriminate between two stimulus orientations (left/right). For each observer and task, we identified the contrast value leading to a visibility threshold of 50% for the yes/no detection and of 75% for the left/right detection and discrimination tasks. The results suggest that strong prestimulus occipital alpha oscillations impair performance only in yes/no detection task, but not in the localisation nor in the orientation discrimination task. These results can be reconciled with previous interpretations of alpha oscillations; namely, weak alpha oscillations are related to a state of increased cortical excitability, which in turn may prime the observer to report stimulus presence. Follow-up studies will investigate the specific effect of prestimulus alpha oscillations on sensory processing and decision-making.

P202 - Subjective experience and representation of space characteristics with minimal distal-to-tactile sensory substitution device Enactive Torch

Weronika Kalwak [1], Marta Lukowska [1], Bartosz Majchrowicz [1], Konrad Werner [1], Michal Wierzchon [1]

[1] Consciousness Lab, Institute of Psychology, Jagiellonian University, Krakow, Poland.

We present two studies investigating subjective experience over minimal distal-to-tactile sensory substitution. Enactive Torch (ET) device was used allowing participants to decode a distance (estimated with the infrared sensor) from a tactile stimulation. Participants were tested within a standardized experimental environment and their access to visual and auditory information was restricted. We assumed that ET becomes more transparent in the course of training. We also expected that representation of space became more complex in the later stages of the procedure. A first study indicated an increase of familiarity and transparency of the device with time. We also observed that not only distance, but also e.g. shapes of objects, spatial relations between objects or object size became salient in the course of training. At the same time participants' performance and verbal reports reflected a unique character of subjective experience of space formed through ET substitution. In the second study we provided participants with two different perceptual information (increase or decrease in vibration strength with decreasing distance) to represent the same environment characteristics by different tactile stimulation. We tested whether distinct perceptual representations led to the very same subjective experience of space characteristics (distance to the object, shapes of objects, spatial relations between objects or object size). In the third study we provided participants with particular perceptual information (by given vibro-tactile stimulation e.g. increasing vibration strength condition), which was then changed (e.g. into decreasing vibration strength condition). We investigated how this manipulation influenced subjective experience of space. Second-person interview and third-person behavioral data collected in those studies are currently submitted to analysis. The results will be discussed in context of phenomenological account as well as in context of hierarchical theories of consciousness.

P203 - Prior expectation shapes dynamics of ambiguous stimulus perception

Fukuda Megumi [1], Gareth Robert Barnes [2], Bahador Bahrami [1], Christoph Mathys [2, 3, 4], Kristian Sandberg [1, 5], Ryota Kanai [6], and Geraint Rees [1, 2]

[1] Institute of Cognitive Neuroscience, University College London, London, UK, [2] Wellcome Trust Centre for Neuroimaging, University College London, London, UK, [3] Max Planck UCL Centre for Computational Psychiatry and Ageing Research, University College London, London, UK, [4] Translational Neuromodeling Unit (TNU), Institute for Biomedical Engineering, University of Zurich and ETH Zurich, Zurich, Switzerland, [5] Cognitive Neuroscience Research Unit, Hammel Neurorehabilitation and Research Centre, Aarhus University, Aarhus, Denmark, [6] School of Psychology, Sussex University, Sussex, UK.

Our conscious percepts correspond to the consequences of resolving ambiguity in visual input. Ambiguity is resolved by the visual system using prior information from history in perceptual decision making (Denison et al., 2011; Wyart et al., 2012; Akaishi et al., 2014; Fischer and Whitney, 2014). The predictive coding theory proposes that the brain makes inferences by combining sensory information with expectation or prior, which is constantly updated by incoming sensory information (Hohwy et al., 2008). We have previously proposed that human parietal cortex (anterior and posterior superior parietal lobule in the right hemisphere, aSPL and pSPL) is engaged in this iterative process (Kanai et al., 2011; Megumi et al., 2015). However, the information content of cross-talk between the aSPL and pSPL remains unknown. Here, we investigated how prior expectation for ambiguous visual information is represented in the brain to resolve ambiguity using bistable structure-from-motion (SFM) stimuli. We measured the brain activity with MEG while participants reported the perceived direction of an intermittently presented bistable stimulus. To manipulate their expectation, we presented disambiguated SFM stimuli using binocular disparity to add depth information (prime stimuli). Ambiguous SFM stimuli (without binocular disparity, ambiguous stimuli) were interleaved within a block of trials whereby the majority of prime stimuli (70% of the prime trials) were disambiguated to the right or to the left rotation depending on the block condition. Results showed that the subjective percepts of ambiguous stimuli were biased towards the disambiguated direction of the block, thereby establishing the successful manipulation of prior expectation. To identify MEG signatures for prior expectation, we constructed a hierarchical Bayesian model (Mathys et al., 2011) to estimate participant's expectation trajectory and explored which regions represent the expectation. Consistent with our hypothesis (Kanai et al., 2011; Megumi et al., 2015), this analysis proved that aSPL and pSPL showed expectation-related signals during the early, pre-stimulus period and the late period following stimulus onset. Together, these results suggest that prior expectations are encoded and updated in the SPLs, and shape the contents of conscious experience.

P204 - Pre- and Post-stimulus neural activity reflecting subjective visibility and objective performance measured with simultaneous EEG/fMRI

Jason Samaha [1]*, Joshua J. LaRocque [1,2]*, Olivia Gosseries [1,3], Giulio Tononi [3], and Bradley R. Postle [1,3]

*** These authors contributed equally.**

[1] University of Wisconsin-Madison, Department of Psychology, [2] University of Wisconsin-Madison, Medical Scientist Training Program and Clinical Neuroengineering Training Program, [3] University of Wisconsin, Department of Psychiatry.

A long-standing question in the science of consciousness concerns the extent to which visual information processing is dissociable from visual awareness. To better understand the spatial and temporal dynamics of neural activity reflecting both how accurately a stimulus is processed and whether it is subjectively experienced, we recording signals from EEG simultaneously with fMRI while subjects performed a visual discrimination task. Backward-masked images of faces and houses were presented at each subject's threshold for visual awareness. On each trial, response accuracy (two-alternative forced choice) and subjective visibility ratings (sliding scale representing maximum to minimum visibility) were recorded. Analyses of the EEG data reveal that pre-stimulus oscillatory activity in the alpha band, measured over posterior sensors, distinguishes between targets subsequently rated as high or low in visibility, but was not predictive of target discrimination accuracy. Further, high vs. low visibility could be successfully decoded from stimulus-evoked BOLD responses in visual and frontal cortices, but stimulus-specific patterns of activity that varied with awareness were present only in inferior temporal cortex. These data suggest that neural processes related to subjective visual awareness can be dissociated

from processes driving objective discrimination accuracy and that subjective awareness may be determined, in part, by the state of the brain prior to stimulus presentation.

P205 - Serial dependence in visual perception and stimulus representation in primary visual cortex

Elexa St. John-Saaltink [1], Peter Kok [1], Hakwan Lau [1,2], Floris P. de Lange [1]

[1] Radboud University, Donders Institute for Brain, Cognition and Behaviour, Nijmegen, the Netherlands, [2] Department of Psychology, University of California Los Angeles, Los Angeles, California, United States of America.

Our perceptual consciousness of the world is partly determined by our knowledge of the statistical regularities in the environment, such as the fact that the world is stable over short time scales. This is reflected by the fact that visual perception is serially dependent, with previously seen stimuli biasing the perception of subsequent stimuli (Fischer & Whitney, 2014). The neural mechanisms of this effect are unclear. Does this trial history effect occur at the level of the higher-order areas involved in perceptual decision making (Gold & Shadlen, 2007), or do preceding stimuli bias stimulus representations at the earliest levels of sensory processing? In this study, we acquired fMRI data in 24 healthy human participants while two grating stimuli were briefly presented in the left and right visual field. On each trial, participants reported the orientation of the grating at the location indicated by a post-stimulus response cue. We used multivariate pattern analysis to extract orientation specific BOLD signals from the primary visual cortex on every trial. We applied multiple regression analyses to isolate the influence of the current and previous stimuli on the behavioural and neural responses. In line with previous reports (Fischer & Whitney, 2014; Liberman, Fischer, & Whitney, 2014), perceived orientation was consistently biased towards the orientation of the preceding stimulus. Strikingly, the orientation signal in V1 was similarly biased towards the orientation presented on the previous trial, suggesting that recently seen stimuli alter low-level sensory representations. Serial dependence was spatially specific such that stimuli on the current trial only showed an influence of previous stimuli at the same location, both in terms of brain and behavior. Finally, when stimulus and perceptual choice diverged, trials were biased by previous choice, rather than previous stimulus. Our study extends previous behavioral reports by revealing a trial history effect at the earliest levels of sensory cortex. This biasing process is spatially specific, and governed by previous choice rather than stimulus. Together, these findings elucidate how our perceptual consciousness is shaped by our perceptual history.

P206 - Magnifying glass optical illusion occurs for multiple stimuli but not for a single stimulus

Saki Takao [1], Aki Kondo [2], Atsunori Ariga [1], Kohsuke Takahashi [2], Katsumi Watanabe [2]

[1] Ritssho University, [2] University of Tokyo

Letters inside an area surrounded by illusory contours look larger than those outside it, even though they are physically same. In this study, we examined if this magnifying glass optical illusion would be observed with other geometric shapes than letters, with solid (non-illusory) lines, and with single rather than multiple shapes. In Experiment 1, participants compared a stimulus group (e.g., an array consisting of six circles) inside a square surrounded by illusory contours or solid lines with that outside it and reported which group appeared larger as a whole. Both illusory contours and solid lines made the multiple circles inside the area appearing larger, replicating the magnifying glass optical illusion. However, it was not the case for a single circle wherever it appeared in the area (Experiments 2 and 3). Furthermore, this illusion was elicited when participants compared the lengths of multiple line segments (Experiment 4). These results suggest that the magnifying glass optical illusion is not confined to illusory contours and not simply due to a general expansion of size of each single stimulus.

SELF & BODY - II

P207 - Is the mirror recognition test a convincing criteria for self-consciousness?

Hui-Ming Chin [1]

[1] Department of Philosophy, University of Alberta, Canada [2] Consciousness Research Group, Taiwan.

Mirror recognition test is an empirical paradigm of animal's self-consciousness, i.e. an organism passing the test will be considered as the self-conscious organism. The main procedure is to test whether an organism can recognize itself in the mirror; if it can, it is self-conscious. The presupposition of the test is that being self-consciousness requires the capacity of recognizing the visual representation of itself, and the organism passing the test has the capacity. However, some philosophers oppose the mirror recognition test as a criteria for self-consciousness by arguing against the presupposition. For example, Tyler Burge argues that passing the mirror test just adduces that the organism can well manipulate its egocentric index, which can be completed unconsciously; so, it does not provides any evidence of being self-consciousness (Burge, 2011). Besides, Lynne Rudder Baker proposes that self-consciousness is derived from the robust first-person perspective, which requires the linguistic capacity of the organism. Since passing mirror test does not require the language capacity, it cannot be a criteria for self-consciousness (Baker, 2013, 2012). To argue for the mirror recognition test, I will try to reply Burge and Baker's oppositions. To reply Burge's view, I will argue that exercising the egocentric index is just the presupposition of passing the mirror test and does not ensure to pass it. Passing the test requires the organism to remember the visual image in its mind and recognize it in the mirror, and thus it is hardly to be done without consciousness. On the other hand, Baker's view of self-consciousness just considers about the reflective self-consciousness. I will introduce Jose Luis Bermudez's view and show that Baker's view, which excludes the bodily self-consciousness, will induce a paradox. Moreover, I will also indicate that both the bodily self-consciousness and the reflective self-consciousness cannot explain the mirror test as a criteria of self-consciousness. I will try to convince that the mirror test as a criteria for self-consciousness infers that there may be a third kind of self-consciousness, which is different from the bodily self-consciousness and reflective self-consciousness.

P208 - First- and third-person perspective taking: the role of vestibular signals

Diane Deroualle [1], Liliane Borel [1], Arnaud Devèze [2] and Christophe Lopez [1]

[1] Aix Marseille Université, CNRS, NIA UMR 7260, 13331, Marseille, France, [2] Service ORL et chirurgie cervico-faciale (Nord). Assistance publique – Hôpitaux de Marseille, France

A main constituent of self-consciousness is referred to as first-person perspective (1PP), allowing to center the experience of space on one's own body. While 1PP is the common viewpoint on the world, infants develop the ability to take another person's viewpoint, or third-person perspective (3PP). 3PP has been proposed to be a crucial feature of social interactions, but its sensorimotor foundations remain underinvestigated. The aim of the study was to determine how the vestibular system, a major sensory system for coding own body rotations and translations in space, contributes to the spatial transformations underpinning 1PP and 3PP taking. We designed a 1st experiment combining natural vestibular stimulation on a full-body motion platform with perspective taking tasks in a virtual environment. To determine whether vestibular stimulation influences specifically perspective taking or more generally mental rotation, a 2nd experiment combined the same stimulation with mental rotation tasks that did not involve changing perspective. In experiment 1, 20 participants realized a virtual ball tossing game during which they adopted the visuo-spatial perspective of avatars. While they performed this task, they were passively rotated on a chair in the clockwise or counterclockwise direction in the same plane as the mentally performed perspective taking. Results showed an interaction between the direction of the chair rotation and the direction of perspective taking. They were faster to take an avatar's perspective when both directions (physical and imaginary) of rotation were congruent. Results also showed that vestibular stimulation had no influence when they performed the task from their 1PP. In experiment 2, 14 participants realized mental rotations of

tridimensional objects in the yaw plane while they were rotated on the chair in the same plane. Results showed no interaction between the direction of chair rotation and the direction of mental rotation of objects. Altogether, these results showed that vestibular information influences differently 3PP taking and mental rotation of objects and they showed the perceptual stability of the egocentric 1PP, that was immune to the vestibular stimulation. In conclusion, while vestibular information seems specifically involved in own body mental imagery, suggesting that it relies on embodied cognitive mechanism, it has no influence on allocentric mental rotation of objects located around the participant's body.

P209 - Rapid resolution of multisensory mismatch enables the recovery of agency and ownership

Nathan Faivre [1,2], Michele Scandola [3], Alexandra Lan Cuenod [4], Roy Salomon [1,2], Silvia Marchesotti [1,2], Javier Bello Ruiz [1,2], Olaf Blanke [1,2,5]

[1] Laboratory of Cognitive Neuroscience, Ecole Polytechnique Fédérale de Lausanne, Switzerland, [2] Center for Neuroprosthetics, Ecole Polytechnique Fédérale de Lausanne, Switzerland, [3] NPSY-Lab.Vr, University of Verona, Italy, [4] University College London Medical School, England, [5] Department of Neurology, University Hospital, Geneva, Switzerland.

Imagine sitting on a train, twiddling your thumbs while looking at the reflection made by your hands on the train's window. Due to the mirror transformation, the flipped visual input does not match with simultaneous bodily inputs including tactile, proprioceptive, and motor signals. Such multisensory mismatches occur constantly in daily life, as each sensory modality is impacted by different sources of noise, is attributed with variable amounts of neural resources, and operate with distinct temporal dynamics. Yet, while a transient multisensory event necessarily results in a cascade of discrepant neural responses, multiple sensory inputs seem to work in unison, and one has the constant feeling of owning ones' limbs (i.e., sense of ownership), as well as being causally related to their actions (i.e., sense of agency). Compensatory mechanisms must take place to correct for multisensory incongruities and account for the observed constancy in agency and ownership. Here, by combining a virtual reality setup with objective and subjective behavioral measures, we assessed with two experiments how the resolution of multisensory mismatches unfolds over time, and how this resolution relates to the recovery of the sense of agency and ownership. Akin to the train situation, participants were asked to perform bimanual movements while receiving visual feedback of their hands as seen from a first-person perspective. In half the trials (flipped condition), a multisensory mismatch was introduced by flipping the visual feedback horizontally, so that the position of the physical hands was opposite to the position of the seen hands. When prompted by a cue with variable onset times, participants had to report which hand they saw was closed as fast and accurately as possible. We observed that reaction times and accuracies were impacted by the multisensory mismatch in the flipped vs. non-flipped condition, but importantly, this effect decreased as exposure to the flipped visual feedback increased, up to 20 seconds. The restoration of performances over time was taken as an objective signature of the mismatch resolution. In addition, we observed higher ratings in the sense of agency and ownership after long exposures to the mismatch, reflecting the consequences of the mismatch's resolution with a subjective measure. Taken together, our results show that important multisensory mismatches are rapidly resolved, which may explain the constancy of agency and ownership.

P210 - Mirror-mediated behavior in pigeons (*Columba livia*) and chickens (*Gallus gallus*)

Alexis Garland [1], Inga Tiemann [2], Mareike Fellmin [2], Emre Ünver [1], Onur Güntürkün [1]

[1] Ruhr University Bochum, [2] Bruno Dürigen Institut - Wissenschaftlicher Geflügelhof.

Mirror self-recognition (MSR) has been explored as a primary cross-species indicator of self-awareness now for several decades, with much controversy. Clear evidence of visual self-recognition by non-human animal species is a matter of much debate, although the list of species with claims to such abilities has grown considerably in recent years. We discuss evidence from two separate studies, one in pigeons (*Columba livia*) and another in chickens (*Gallus gallus*). In some bird and mammalian species, an 'audience effect' is apparent in the context of either alarm or food calls, where an individual will only

make a call if an audience (typically conspecifics) is present. For roosters (male *Gallus gallus*), this appears to be the case when making alarm calls warning of aerial predators. This has allowed us to experimentally explore whether the audience effect is present within the context of reflected image, as opposed to a conspecific. In pigeons, we presented a task requiring subjects to use the reflected image of food as a cue in order to successfully retrieve the out-of-sight food reward. Results indicate the salience of peripheral vision in such tasks, and may shed new light on previous avian experiments focusing on similar mirror-mediated tasks. Both of these studies provide new information that give us a more nuanced understanding of how avian species interact with mirror images.

P212 - Self-location and body-location: are they the same ?

Hsu-Chia Huang [1], Yen-Tung Lee [2], Wen-Yeo Chen [1], , Sufen Chen [3], Caleb Liang [1,2]

[1] Graduate Institute of Brain and Mind Sciences, College of Medicine, National Taiwan University, [2] Department of Philosophy, National Taiwan University, [3] Graduate Institute of Digital Learning and Education National Taiwan University of Science, Taipei, Taiwan.

“Self-location” is the subjective feeling of where I am, or more precisely, the sense of where my first-person perspective is located relative to other things. Many researchers agree that self-location is a crucial aspect of bodily self-consciousness, and this view is supported by recent studies of full-body illusions (FBI; Lenggenhager et al., 2007; Antonella Maselli et al., 2014) We first argue that what was measured in many previous studies should be more accurately called “body-location” (the sense of where my body is). We designed experiments to investigate whether self-location and body-location are really the same phenomena. Adopting the set-up in Lenggenhager et al. (2007), subjects watched their own body standing in front of them, and were brushed synchronously or asynchronously. Then we manipulated their sense of self-location and body-location by (A) asking the participants to make marching movements without moving forwards, and/or (B) swiftly moving the stereo camera close to their body, or (C) swiftly moving the stereo camera away from their body. Questionnaire data suggested that self-location and body-location are dissociable...

P213 - Mental Sex: A Pilot Study on Resting State Connectivity and the Fluidity of Gender Identity

Sara Kimmich [1,3,5], Laura Case [6,7], VS Ramachandran, [6,7], and Lisa T. Eyler [2,3,4,5]

[1] UCSD Department of Cognitive Science, [2] UCSD Department of Psychiatry, [3] Veterans Medical Research Center, [4] Veterans Affairs Hospital, [5] UC San Diego, [6] Center for Brain and Cognition, [7] UCSD Department of Psychology.

Identifying the biological aspects of gender identity has undeniable scientific and social implications, as gender is often considered to be a central component of the conscious self. Neuroscientific research has yet to examine the neural correlates of mental sex, and observing resting state connectivity within an individual with Alternating Gender Identity (AGI) offers a rare opportunity to understand the biological foundations of gender in the brain. In this study, functional magnetic resonance imaging and endocrinological measures were used to examine changes in resting state connectivity and endogenous hormonal fluctuations in male and female gender states in an AGI participant. Resting state scans revealed greater connectivity in the default mode network in the male state, and more connectivity in the dorsal attention network in the female state when compared to cisgendered male and female controls. These findings provide invaluable insight into the functional differences of gendered states in consciousness and a theoretical foundation for further research in the field.

P214 - When one's own thoughts are externally-generated: neural correlates of an altered feeling of authorship

Leonie Klock [1,2,3], Martin Voss [3], Markus Weichenberger [2], Norbert Kathmann [2], Simone Kühn [3,4]

[1] Berlin School of Mind and Brain, Germany, [2] Department of Psychology, Humboldt-Universität zu Berlin, Germany, [3] Charité – Universitätsmedizin Berlin, Germany, [4] Max Planck Institute for Human Development, Berlin, Germany.

Schizophrenia patients experiencing thought insertion describe their own thoughts as alien and as being controlled by external forces. The aim of this study was to investigate the neural correlates of these remarkable thought monitoring processes in healthy participants. A novel coverstory encouraged participants to actively monitor their own thoughts regarding the unusual question of whether their thought is self- or externally-generated. In this fMRI study participants were told that they will take part in a combined transcranial magnetic stimulation (TMS) and fMRI study. It was explained that thinking about an animal causes enhanced neural activity in a specific prefrontal cortical region. They were told that TMS stimulation of exactly this area during the experiment triggers a thought of an animal. Please note that in fact no TMS device was installed in the scanner and thus no pulse was actually applied. At the beginning of each trial a colored circle informed the subjects about the supposed operation mode of the TMS device (green: TMS on, red: TMS off, orange: TMS either on or off). Subsequently they were asked to think about an animal for an interval of 10 seconds and to monitor their thoughts regarding the question of who generated the thought. Importantly, the only difference between the conditions is the participant's belief regarding the external influence on their thoughts. In total 29 subjects rated in 80 trials the perceived authorship of their thoughts on a visual analog scale (ranging from "TMS" to "ME"). Especially relevant for the ambiguous orange condition was the judgment of whether they believed that the fictional TMS was switched on or off. fMRI data during the interval, in which subjects monitored their own thoughts (orange cue), was contrasted based on whether they believed the TMS was switched on or off. Subjects reported significantly less authorship and attributed the thought more to the TMS when they believed it was switched on compared to when it was off. Comparison of orange trials in which subjects rated the TMS as on versus off shows an increased BOLD response in the dorsal medial prefrontal cortex (dmPFC), which is negatively modulated by authorship ratings. The dmPFC has previously been associated with reflecting about other people and disengaging from a strong self-perspective (Lynn, Muhle-Karbe & Brass, 2014). Therefore, our results further suggest a role of the dmPFC in the process of distancing from own thoughts.

P215 - Seeing one's face at the rhythm of one's heart: how externalized interoceptive signals shape self-other face discrimination

Giuseppina Porciello [1], Moritz Daum [2], Peter Brugger [3] & Bigna Lenggenhager [3]

[1] Sapienza University Rome, [2] University of Zurich, [3] University Hospital of Zurich.

Increasing evidence suggests that our sense of bodily self is built on multisensory bodily signaling and its integration with external information. Experimental paradigms, performed on healthy participants, have thus increasingly used situations of multisensory conflicts in order to alter various aspects of the bodily self, such as ownership, self-location or self-recognition and face discrimination (Sforza et al. 2010). While earlier research has been mainly based on mismatch between visual, tactile and proprioceptive information, recent evidence has suggested that visuo-cardiac conflicts can alter certain aspects of the bodily self (Aspell et al. 2013, Suzuki et al. 2013). Here we investigated whether cardiac signaling might influence self-other face discrimination. We presented ambiguous self-faces (i.e. morphed with a stranger's face at various percentages), and in a control task ambiguous friends' faces, either synchronously or asynchronously with participants' heartbeat. In line with previous research, we expected a self-bias during the synchronous condition. A first study with 31 healthy female participants did, however, not reveal any difference between the conditions. A follow-up study, where the asynchrony between flashing of the visual stimuli and the participants' heartbeat was increased revealed altered self-attribution scores during the asynchronous condition. Specifically, participants showed less self-attribution of ambiguous morphed stimuli during the asynchronous visuo-cardio condition. This might suggest that, in contrast to our hypothesis, mismatch conditions may be particularly disruptive to self-

attribution. Interestingly, data collected by measuring participants' actual heart rate during the task suggest an adaptation of the rate towards the frequency of the visual flashing (i.e. a higher frequency) which was specific during self-related faces/judgments and not present during the friend's face presentations. Together, these results confirm and expand previous findings by underlining the importance of the integration of internal and external bodily signals also for self-face recognition.

P216 - Neurological and Robot-Controlled Induction of an Apparition

Polona Pozeg [1,2], Giulio Rognini [1,2,3], Andrea Serino [1,2], Roy Salomon [1,2], Hannes Bleuler [3], Olaf Blanke [1,2,4]

[1] Center for Neuroprosthetics, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, [2] Laboratory of Cognitive Neuroscience, Brain Mind Institute, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, [3] Laboratory of Robotic Systems, School of Engineering, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, [4] Department of Neurology, University Hospital of Geneva, Geneva, Switzerland.

The feeling of a presence (FoP) is a strange sensation that somebody is nearby when no one is actually present and cannot be seen. This phenomenon of a sensed invisible presence has for long influenced art and literature in a variety of cultures, and although it has been often reported by neurological and psychiatric patients, as well as healthy individuals in extreme situations, the neural mechanisms of the FoP have not been well understood yet. A lesion analysis and analysis of the associated hallucinations and neurological deficits in 12 FoP patients showed that the FoP was associated with sensorimotor loss and caused by lesions in three brain regions: temporoparietal, insular, and frontoparietal cortex (Blanke et al., 2014). By integrating these findings with principles of multisensory body perception, we designed a master-slave robotic system that generated specific sensorimotor conflicts in order to study the FoP in healthy subjects. Blindfolded participants moved the master device in front of them, while trajectories and force of their movements were sent to the slave robot, which in real-time applied touch to the participant's backs. In a series of three experiments we manipulated the temporal delay between the participant's movements and the received tactile feedback, and assessed the FoP through spontaneous reports, questionnaires and behavioral tasks. We showed that asynchronous stimulation (as compared to synchronous) induced an increased sensation of being touched by someone else and feeling of being in a presence of another person. Coherently with such FoP-related feelings, participants also estimated that more persons were present in the room in the asynchronous, FoP –inducing, condition. We explain our findings in the framework of predictive models, which claim that efferent copy signals from the sensorimotor system are used to make predictions about the sensory consequences of movement and that such integration is required for normal action and bodily awareness. Alterations in the congruency between sensorimotor predictions and feedback signals - due to brain lesions or appropriate experimental manipulations - cause the misperception of the source and identity of own sensorimotor signals, resulting in the feeling of a presence of another agent. These findings advance the understanding of brain mechanisms involved in construction of boundaries between self and other and their role in positive symptoms in schizophrenia.

UNCONSCIOUS PROCESSES

P217 - Prior Expectation Modulates Repetition Suppression without Perceptual Awareness

Leonardo S. Barbosa [1], Sid Kouider [1]

[1] Laboratoire de Sciences Cognitives et Psycholinguistique (ENS, CNRS, EHESS), PSL Research University, Paris, France;

Neural activity induced by a visual stimulus is usually reduced when it is presented a second time. This phenomenon, known as repetition suppression (RS), is very robust and classically held to stem from neuronal adaptation to the stimulus physical properties (Grill-Spector et al., 2006). More recently, RS was linked to the framework of Bayesian mechanisms of brain function (Rao & Ballard 1999, Friston 2005). While the former account entails that RS should depend only on the physical characteristics of

the stimulus, in predictive coding RS results from a comparison between predicted, top-down information, and the actual sensory evidence. Indeed Summerfield et al. (2008) showed that RS depends on the probability of repetition, while Larson & Smith (2012) found that this effect was only present when subjects performed a task on the repeated stimulus, vanishing when they attended a task-irrelevant sequence. These results might suggest that the effect of expectation depends on high-level mechanisms other than the context induced by repetition probability. Here we used a subliminal priming paradigm combined with EEG recordings while varying the probability of repetition, and showed that RS was present only when a repetition was expected, independently of awareness of the cue. By contrast, the effect inverted into a repetition enhancement when an alternation was expected, but only for the supraliminal cases. We argue that this provides evidence for automatic non-conscious influence of high-level context in RS, affecting early perceptual components.

P218 - Unconscious temporal predictive processing revealed by 10 Hz perceptual echo

Acer Y.-C. Chang [1,2] , Rufin VanRullen [3,4] , Ryota Kanai [2,5], Anil K. Seth [1,2]

[1] Department of Informatics, University of Sussex, Brighton BN1 9QJ, United Kingdom, [2] Sackler Centre for Consciousness Science, University of Sussex, Brighton BN1 9QJ, United Kingdom, [3] CNRS, Centre de Recherche Cerveau et Cognition, Faculté de Médecine de Purpan, Toulouse, France, [4] Université Paul Sabatier, Toulouse, France, [5] School of Psychology, University of Sussex, Brighton BN1 9QH, United Kingdom.

The influential predictive processing framework posits that the brain continuously generates and updates predictions about incoming sensory signals. So far, little is known about how the visual system tracks temporal regularities and makes prediction in a fast changing environment. By analysing cross-correlations between visual inputs and electrophysiological (EEG) signals, VanRullen and Macdonald (2012, *Current Biology*) found that, when presenting a dynamic sequence randomly modulated in luminance, the occipital EEG response implemented a reverberation or “echo” of the input sequence, specifically in the alpha (~10 Hz) frequency. The long-lasting nature of perceptual echoes – in the timescale of seconds – suggests a role in the representation of sensory information over time. We wondered whether perceptual echoes might serve a function within visual predictive processing. We hypothesized that the visual system iteratively predicts and updates temporal representations within a cycle defined by occipital alpha. We tested this hypothesis by making the visual input more predictable. The same 3.125s random luminance sequence was repeated four times across four successive trials. If the echo phenomenon is sensitive to stimulus predictability, we expect to see a relationship between echo amplitude and number of repetitions. The result showed that the power of perceptual echo for the fourth presentation was significantly larger than for the initial and second presentations. This indicates that perceptual echo was sensitive to predictable information. Time-frequency analysis of the echo response further showed that the alpha power for the fourth presentation was stronger than for the initial presentation between 380 to 450ms. This result indicates that the visual system takes about 380ms to recognise the repeated temporal pattern. In contrast, frequency analysis of EEG signals (i.e., without cross-correlation to extract echo response) showed no difference in alpha power between different conditions, suggesting that perceptual echo enhancement was driven by a predictive process specific to sensory inputs, but not by the intrinsic alpha rhythm. None of the 14 participants noticed the presence of the repeating sequences in the whole experiment. Our results suggest a mechanism by which the visual system can unconsciously track rapidly changing temporal regularities of visual inputs to generate and update predictions based on previously encountered regularities.

P219 - Sleepwalking under Cognitive Load – the Zombie’s Apprentice

Kannape, Oliver A [1], Blanke, Olaf [2,3,4]

[1] School of Psychology, University of Central Lancashire, Preston, UK, [2] Center for Neuroprosthetics, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, [3] Laboratory of Cognitive Neuroscience, Brain-Mind Institute, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, [4] Department of Neurology, University Hospital Geneva, Geneva, Switzerland.

Sleepwalking is a common parasomnia during episodes of which individuals may perform highly practiced yet complex movements in the absence of conscious control – reminiscent of the philosophical zombie. Yet to date no overt differences have been reported in awake behaviour. We investigated a group of clinically diagnosed sleepwalkers (N=11) and matched controls using a goal-directed walking paradigm in a VR environment with (DT) and without (ST) a concurrent cognitive task (articulated backwards counting in 7s). Feedback was veridical or deviated by 5 to 30° (L/R). Motor awareness (MA) Y/N replies were collected after each trial. Our results illustrate that motor performance and MA, comparable under ST, significantly differed between sleepwalkers and controls under cognitive load. Our findings suggest comparable MA mechanisms in both groups, independent of load, but a stronger automation of sensorimotor control in the sleepwalkers, echoing the behaviour evident in such nightly episodes.

P220 - Does temporal integration of semantic information occur under visual crowding ?

Kuei-An Li [1], Jifan Zhou [1,2], Chia-Lin Lee [1,3,4,5], Yung-Hsuan Tien [1], and Su-Ling Yeh [1,3,4]

[1] Department of Psychology, National Taiwan University, Taipei, Taiwan, [2] Department of Psychology and Behavioral Sciences, Zhejiang University, Hangzhou, China, [3] Graduate Institute of Brain and Mind Sciences, National Taiwan University, Taipei, Taiwan, [4] Neurobiology and Cognitive Neuroscience Center, National Taiwan University, Taipei, Taiwan, [5] Graduate Institute of Linguistics, National Taiwan University, Taipei, Taiwan.

Visual crowding – the inability to see an object when it is surrounded by flankers – does not block semantic activation: unrecognizable words due to visual crowding still generate robust semantic priming in a subsequent lexical decision task (Yeh, He, & Cavanagh, 2012). Based on the previous finding, we further explored whether unrecognizable crowded words can be temporally integrated into a phrase under visual crowding. We presented the first three words of a Chinese four-word idiom, one word at a time for 500ms, either crowded or not, followed by an isolated target word that was an appropriate or inappropriate ending of the idiom. Participants were asked to judge whether the ending word was a word or non-word. Results showed that, compared to appropriate ending, reaction times were slower and accuracy lower for inappropriate ending trials when the words were not crowded. However, no such effect was found when they were crowded. To ensure the null results of crowded words were not due to the presentation duration of each word, we reduced the duration to 250ms per word. The result remained the same. A classical N400 experimental design was further adopted and results showed that only when the words were recognizable, inappropriate ending trials evoked larger N400. Both behavioral and ERP measures do not seem to support the existence of temporal integration under visual crowding, as the congruency effect only occurred when the words were not crowded. These results suggest that consciousness might be necessary for the integration of temporally separated words, at least under the visual crowding condition we tested in the current study.

P221 - Scene integration during continuous flash suppression: No evidence that scene congruency modulates suppression times

Pieter Moors [1], David Boelens [1], Johan Wagemans [1]

[1] Laboratory of Experimental Psychology, University of Leuven, Leuven, Belgium.

The scope and limits of unconscious visual processing are a central research topic in cognitive neuroscience. Recently, Mudrik et al. (2011) reported that visual awareness is not needed for object-background integration in visual scenes, a process considered to be complex and high-level. In this study, continuous flash suppression (CFS) was used to suppress scenes from visual awareness and observers had to indicate as quickly as possible when the scenes broke through the CFS mask. Mudrik et al. showed that scene congruency modulates suppression times such that incongruent scenes broke suppression faster than their congruent counterparts, inferring that the semantic relationship between objects and scenes can be analyzed in the absence of visual awareness. In this study we set out to replicate the result reported in the study of Mudrik et al. (2011) in a sample more than twice as big as in the original study. Furthermore, to ensure that scene congruency effects were due to genuine scene processing and not to low-level differences between different scenes, we included a condition in which the scenes were presented inverted rather than upright. Our results ($n = 45$) indicate a significant inversion effect (inverted scenes break suppression slower), but no evidence for a congruency effect, and critically, no interaction between scene congruency and inversion. Notably, at several steps during the data collection process a significant congruency effect was observed (congruent scenes broke suppression faster than incongruent scenes, however). In contrast, a more conservative Bayes Factor analysis indicated stronger evidence for the absence of a congruency effect as more data were collected. Thus, in a sample more than twice as big as in the original study, we failed to replicate the originally reported scene congruency effect that incongruent scenes break suppression faster than congruent scenes. We did observe an inversion effect, however, suggesting that the stimuli were indeed processed during suppression. Our data therefore suggest that complex scene processing presumably does not take place during CFS.

P222 - Are implicitly and rapidly acquired Stimulus-Response associations consolidated ?

Karolina Moutsopoulou [1,2], Andrea Kiesel [3], Christina Pfeuffer [3], Qing Yang [1,2], Florian Waszak [1,2]

[1] Université Paris Descartes, Sorbonne Paris Cité, Paris, France, [2] CNRS (Laboratoire Psychologie de la Perception, UMR 8158), Paris, France, [3] University of Freiburg, Germany.

In implicitly built Stimulus-Response associations, task and motor information are independently associated to the stimulus. Such independent component associations have been shown to be built even during the first presentation of the stimulus and a classification of that stimulus to one category is made (Stimulus- Classification association; S-C) and an action is executed as a response to the stimulus (Stimulus-Action association; S-A). These two types of rapidly formed associations have durable effects on behaviour that can last from seconds up to at least a few minutes. Given the speed of creation of these associations as well as their durability, we investigated their longevity in order to determine whether they are stored in working memory or longer-term memory systems. In one study we show that after two instances of a stimulus with a Classification task and a particular motor response, both S-C and S-A associations have an effect on behaviour when tested 2-7 trials after encoding. In addition, the S-C association was detectable behaviourally even 24 hours after learning while the S-A association was not. Interestingly however, a re-emergence of the S-A effect was observed 1 week after testing, implying consolidation of the S-A link across a long period of time. The results are discussed in terms of the systems that may support rapidly and implicitly formed S-R component associations as well as in terms of the possible role of consolidation in their longevity.

P223 - Temporal characteristics of retaining an unconscious visual target

Shun Nakano [1], Masami Ishihara [1]

[1] Tokyo Metropolitan University.

The present study aims to elucidate whether unconscious information could be stored for a certain period of time. We conducted two experiments using a backward masking paradigm. In each experiment, a circular visual target was presented briefly (50 ms) at one of four locations on a computer screen and then masking stimuli appeared (1000 ms) to mask the target. In Experiment 1, time intervals (0, 1000, 2000, or 3000 ms) between the offset of masking stimuli and the onset of test stimuli, which serve as a probe of asking the target location, were experimentally manipulated. Participants were required to choose the target location by pressing one of the four response buttons as quickly and accurately as possible. Accuracy and reaction time (RT) for the response were measured. The result showed that the mean percentage of correct responses appeared to be significantly above the chance level (25%) in all time intervals. No significant difference was found among them. The mean RTs for the shortest interval condition (i.e., 0 ms) were longer than the others. These results suggest that participants could choose the unconscious target location even at 3000 ms of the interval. In Experiment 2, participants were asked just to press one of the four response buttons as quickly and “randomly” as possible when the test stimuli were presented. The time interval was set at 1000 ms only. The main purpose of running this experiment was to confirm whether participants could successfully ignore the influence of such an unconscious target (i.e., random choice per se) or not (i.e., priming effect; responding with the bias of retained target location). The result showed that the accuracy did not reach the chance level significantly. No effect was found in RTs. These results suggest that responding to the target “selectively” is necessary to increase the percentage of correct responses above the chance level. In sum, the present study revealed that the unconscious information can be stored for a certain period of time. The mechanism underlying the choice process for an unconscious target would be different from that of the subliminal priming process. The selective response to the unconscious stimulus could be mediated by retaining its spatial location.

P224 - Effect of Temporal Regularity without Awareness

Sei Hwan Oh [1,2], Po-Jang Brown Hsieh [2]

[1] Agency for Science Technology and Research, Singapore, [2] Duke-NUS Graduate Medical School, Singapore.

It is well known that temporal regularity/expectation may influence perceptual judgments. However, whether awareness of temporal regularity is necessary to influence perception remains unclear. Here we presented participants with two streams of noise patches dichoptically: with temporal regularity in one eye and temporal irregularity in the other eye. Because the two streams of noise patches were spatially overlapping in the fovea and never co-occurred simultaneously, participants perceived them as one stream of irregular noise patches without awareness of the hidden temporal regularity in one eye. Participants were required to perform an orientation discrimination task on targets, which were brief visual Gabor gratings tilted either 45 degree clockwise or counter-clockwise, embedded within one of the two streams. Contrast levels of targets in each stream were adjusted separately across trials using staircase procedure and thresholds of targets in each stream were measured independently. The results showed that unconscious temporal regularity in one eye still enhanced subsequent contrast sensitivity of the embedded targets, suggesting that awareness of temporal regularity is not necessary to influence perception.

P225 – Temporal dynamics of unconscious salience processing

Joo Huang TAN [1], CHONG Jun Hong Dominic [1], Po-Jang HSIEH [1]

[1] Neuroscience and Behavioural Disorders Programme, Duke-NUS Graduate Medical School, Singapore.

In our visual system, incoming signals are processed unconsciously and passed through the processing hierarchy before it reaches our conscious awareness. Saliency is a factor that has been demonstrated to facilitate selection of an object for further processing along the visual hierarchy.. However, the effect of saliency on the temporal dynamics of unconscious processing remains unclear. Here, we employed the continuous flash suppression (CFS) paradigm in an electroencephalography (EEG) experiment to investigate the effects of saliency on an object's ability to compete for awareness. We demonstrated that mean amplitude of electrodes in the frontal regions differ in the presence of an unconscious salient feature singleton. This difference was evident from 200ms following unconscious stimulus onset. This finding confirms previous behavioural observations that salient features modulate unconscious visual processing. More importantly, we extend the current understanding of the temporal dynamics of unconscious visual processing and its effect on our conscious awareness.

P226 - Temporal Integration of Semantic Information under Continuous Flash Suppression

Yung-Hsuan Tien[1], Su-Ling Yeh[1,2,3]

[1] Department of Psychology, National Taiwan University, Taipei, Taiwan, [2] Graduate Institute of Brain and Mind sciences, National Taiwan University, Taipei, Taiwan, [3] Neurobiology and Cognitive Science Center, National Taiwan University, Taipei, Taiwan.

Integrating words across time and space is necessary for understanding the meaning of sentences. Recent research suggests that spatial integration of semantic information can be accomplished unconsciously. However, it remains unknown whether temporal integration of individual words into phrases depends on consciousness. Using the continuous flash suppression (CFS) paradigm, we presented the first three words of Chinese four-word idioms—one word at a time—to one eye, and dynamic Mondrian masks to the other eye, followed by an unmasked target. The target was an appropriate ending of the idiom, an inappropriate ending, or a non-word. Participants' task was to judge whether the target was a word or a non-word, followed by a subjective visibility check of the masked words. Reaction times to the lexical decision task were affected by the appropriateness of the ending word, suggesting that semantic information can be integrated through time even though they were invisible. Participants responded faster to appropriate-endings than inappropriate-endings when the primes were visible, but an opposite pattern was found when the primes were invisible. We conclude that high-level semantic information can be integrated over time unconsciously under continuous flash suppression, and consciousness modulates the effect induced by such temporal integration of semantic information.

