Toward a Science of Consciousness

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to find that all cell types studied to date exhibit mechanosensitivity [2]. Bone cells, for example, respond to mechanical loadings (including muscle contractions) by triggering bone remodeling processes in order to maintain optimal bone density and shape. In the peripheral nervous system, mechanoreceptors (e.g., for touch and pain) translate mechanical signals into neuronal signals. In contrast, the typical brain cell likely needs considerable buffering from externally-applied mechanical loadings – a buffering provided to a large extent by the maintenance of an optimal intracranial pressure to keep the cranial compartment in a state of volume equilibrium. This allows normal brain cell functioning (including interpreting information sent by mechanoreceptors) to proceed without interference from external forces, such as those generated by normal head move-ments. As one example of interference, as assessed at the subcellular level, compression of rat pyramidal cells induces phosphorylation of MAP2 and tau, thereby destabilizing dendritic MTs and deforming dendrites [3]. At the level of consciousness and behavior, case reports of tumors pressing againstamygdalae suggest that this pressure can trigger bizarre and violent thoughts and feelings that are often externalized as aggression [4]. Given that CTS components have been plausibly linked to conscious processing (e.g., cholinergic system theory [5, 6] and ORCH-OR theory [7]), a possible role for "simulated mechanotransduction" for generating "covert actions" (thoughts and feelings) will be discussed. References: [1] Denton et al. (2003) Bio Systems 71:297-303; [2] Rubin et al. (2006) Gene 367:1-16; [3] Chen et al. (2010) Journal of Neurotrauma 27:1657-1669; [4] Nakaji et al. (2003) Pediatrics 112:e430; [5] Perry et al. (1999) Trends in Neu-rosciences 22:273-280; [6] Woolf & Butcher (2011) Behavioural Brain Research 221:488-498; [7] Hameroff (2001) Annals of the New York Academy of Sciences 929:74-101. **C6**

142 Scale-Free Brain Activity Biyu Jade He <biyu.jade.he@gmail.com> (NIH/NINDS, Bethesda, MD)

Scale-free dynamics is exhibited by many complex processes in nature. Despite long-held interests in fields such as physics and heart physiology, it has so far been largely neglected in mainstream neuroscience research, partly due to its universality. In this talk I will show that underlying the same power-law distribution, the temporal structures of scale-free dynamics vary from one system to another. This suggests that it is important to go beyond the mask of the power-law distribution and explore the fine spatiotemporal patterns and underlying mechanisms of scale-free brain activity. I will further discuss recent findings demonstrating the functional significance of scale-free brain activity, obtained with both intracranial EEG and fMRI in humans. Lastly, the low-frequency end of scale-free brain activity, termed the "slow cortical potential", has been studied in EEG research for decades, and has recently been shown to be an electrophysiological correlate of the fMRI signal. Its correlation with conscious awareness under various experimental conditions will be discussed. **PL4**

143 Metal Correlates of Consciousness and Cognition Elan Ohayon, Ann Lam <ohayon@salk.edu> (The Green Neuroscience Laboratory, La Jolla, CA)

In the current human condition there is no life or consciousness without metals. Sketch of proof: consciousness is dependent on breathing via hemoglobin; take away iron, lose hemoglobin and consciousness is gone. However, little is known of the more subtle interweavings of metals, consciousness and cognition. In this study, we explore the distribution and co-localization of metals across scales in the human brain. We used synchrotron-based rapid scan imaging at whole hemisphere levels, as well as microprobe imaging to examine large-scale morphometric features and underlying brain microstructures of postmortem samples. Two-dimensional scans showing the distribution elements (including iron, zinc, calcium, copper, and selenium) were mapped using beamlines at the Stanford Synchrotron Radiation Lightsource. Comparisons between- and within-subjects helped reveal differences in elemental distributions between brain areas. For example, initial rapid scans showed the expected high-levels of iron in grey matter structures such as the caudate putamen and globus pallidus, while exhibiting prominent zinc fluorescence along white matter tracts. The extent of variations in elemental concentrations within these structures at the cellular level was further studied with microprobe analysis. Elemental maps of unstained tissue were able to show the degree of iron, zinc and calcium co-localization at resolutions exceeding

1 micron. The application of these synchrotron-based techniques is thus providing novel methods to study the correlation of metals on brain function across large areas, while allowing for co-registration at high resolutions at the cellular level. Ongoing multi-scale investigations include comparisons of varying cognitive conditions including: Williams Syndrome, epilepsy and typical brain development. **P1**

144 Towards a Second-Person Neuroscience of Social Cognition Tobias Schlicht <tobias.schlicht@rub.de> (Philosophy, Ruhr-Universite Bochum, Philosophy, Bochum, Germany)

Philosophers and scientists strive to unravel the psychological processes and neural mechanisms enabling our ability to understand others. But despite the remarkable progress of the science of consciousness, and the more recent apparent success of social cognitive neuroscience, we are still in the dark about the nature of social cognition and its underlying mechanisms. Traditionally, theory-theory and simulation-theory have dominated debates on this topic and thus shaped experi-ments designed to uncover the neural correlates of social cognition (cf. Newen & Schlicht, 2009). This led to the discovery of two (anatomically different) large-scale neural networks apparently supporting the respective theories: while the so-called "mentalizing system" seems to support the theory-theory, supposedly giving us an inferential, reflective (i.e. "third-person") grasp of others' mental states (Frith & Frith, 2006, 2010), the "mirror neuron network" seems to support the simulation-theory, supposedly giving us a "first-person grasp" of the motor goals and intentions of other individuals (Rizzolatti & Sinigaglia, 2010). It has been argued that the disparity between these results may be due to differences in the experimental paradigms used (cf. Keysers & Gazzo-la, 2007), such that they presuppose the very frameworks they are taken to support. However, both sets of results share a commitment to a "spectator conception" of social cognition (Hutto 2008), according to which a detached observer evaluates someone else without interacting with them (cf. classical false belief tests). This paper presents conceptual tools of an alternative second-person approach to social cognition and argues for the need of a second-person neuroscience, which will help neuroscience to really go social. Previous empirical research in social neuroscience has focused on the perception of inert stimuli "consistent with the idea of a detached observer;" whereas, in everyday life, making sense of others requires both emotional engagement and interaction. Thus, recent conceptual and empirical developments consistently indicate the need for investigations which allow the study of real-time social encounters in a truly interactive manner. This suggestion is based on the premise that social cognition is fundamentally different when we are interacting with others rather than merely observing them. Firstly, it is unclear whether and how activity in the large-scale neural networks described above is modulated by the degree to which a person does or does not feel actively engaged in an ongoing interaction and whether the networks might subserve complementary or mutually exclusive roles in this case (Schilbach, 2010). Secondly, new experiments based on a second-person framework may shed light on the complex relationship between (unconscious) implicit and (conscious) explicit processes involved in social cognition (Frith & Frith, 2008). For example, ontogenetically we may become experts in social cognition through active interaction, until later, more reflective social abilities may develop which could make use of the very same neural mechanisms forged during social interactions (cf. Karmiloff-Smith, 1992). This is consistent with the "re-use" principle of neural circuits (Ander-son, 2010). Finally, the relevance of this approach for our understanding of psychiatric disorders construed as disorders of social cognition (e.g. autism) is highlighted. **C11**

145 The Neuroscience of Vipassana Meditation: Why and How? Stephen Whitmarsh, Mark Leegsma <stephen.whitmarsh@gmail.com> (Computer Science, Radboud University, Nijmegen, Netherlands)

The premise of the Towards a Science of Consciousness Conference is that a unified science of such a kind doesn't yet exist. We agree, more or less tacitly, that there is no agreement, and we desire rather than possess a paradigm. In particular, a definition of the target phenomenon that is both unequivocal and satisfying appears to be lacking. Yet, scientists of consciousness usually proceed as if such a definition were already available. In good pragmatic fashion, we assume a priori that consciousness is an object and exists in an observer-independent way; presumably all