psychopathy has been shown to be associated with a lack of fear and stress reactivity. Recent work by Kramer, Bayevsky, Krueger, and Patrick (submitted) has demonstrated the presence of an underlying bipolar personality dimension of fear/fearlessness (labeled Trait Fear), bridging measures within these domains. Physiological patterns of reactivity parallel these personality associations, with greater aversive startle potentiation evident in phobias, and decreased potentiation in psychopathy. In the current study, we investigated the association between scores on the Trait Fear dimension and startle potentiation during aversive picture viewing in a sample of 88 undergraduates. Blink responses to noise probes were recorded during pleasant, neutral, and unpleasant pictures selected from the IAPS database. A significant positive association was found between Trait Fear scores and magnitude of aversive startle potentiation for threat pictures in particular. Interestingly, however, smaller or nonsignificant associations were evident between aversive startle potentiation and trait measures of negative emotionality, suggesting that potentiated startle is related specifically to the construct of dispositional fearfulness, rather than to negative emotionality more broadly. Implications for understanding mechanisms of underlying vulnerability and immunity to internalizing disorders will be discussed.

FRIDAY, OCTOBER 23, 2009

Symposium 3.1

THE NEUROSCIENCE OF COROLLARY DISCHARGE: CRICKETS TO SCHIZOPHRENIA

Chair: Judith Ford, University of California, San Francisco

All animals have a mechanism allowing them to navigate the environment without being distracted by the sensations resulting from their own movements. As an animal initiates actions, copies of the action (corollary discharges) are sent to sensory regions of the nervous system. If the copy matches the sensation, the sensation is cancelled or dampened, and tagged as coming from "self." As methods to record neural activity from moving animals improve, our understanding of corollary discharge circuits across species advances. This symposium brings together neuroscientists discussing commonalities across species of the neural basis of corollary discharge. James Poulet will describe a corollary discharge interneuron in the cricket that allows the insect to chirp at high volume without deafening itself. Marc Sommer studies how the corollary discharge of saccadic eye movements in primates creates stable visual percepts from jumpy, saccade-disrupted retinal images, via integration of visual and movement signals at the single neuron level. Christian Bellebaum examines corollary discharge in thalamic lesion patients in Sommer's saccadic double-step task; patients with unilateral lesions showed pronounced impairments for saccades contralateral to their lesion. Dan Mathalon will discuss EEG studies on corollary discharge abnormalities in schizophrenia that may help to explain auditory hallucinations and avolition/apathy. This ubiquitous mechanism provides an opportunity for translational neuroscience, as homologues of symptoms of mental illness can be developed in non-human species.

COROLLARY DISCHARGE DYSFUNCTION IN SCHIZOPHRENIA

Daniel H. Mathalon, Brian J. Roach, & Judith M. Ford
University of California, San Francisco

A plan to execute a motor act is accompanied by a corollary discharge of the expected sensation resulting from the action. An internal comparison is made between the corollary discharge and the actual sensation; the closer the match, the greater the suppression of sensation. Evidence suggests that schizophrenia is characterized by dysfunction of this mechanism, altering patients' experience of their own thoughts and actions and contributing to hallucinations and perceptual aberrations. In 24 patients and 25 controls, phase coherence of single-trial electroencephalography (EEG) preceding talking was calculated across trials. N1 event-related potentials to "ah" onset during Talking and Listening were compared. In another experiment, patients ($N = 21$) and controls ($N = 25$) pressed a button to hear their own pre-recorded "ah", with zero or 50 ms delays between pressing and hearing. Both self-generated sequences of "ahs" were played back during Listening. In healthy controls, pre-speech synchrony was related to suppression of responsiveness to the "ah" as reflected in N1 reduction during Talking. Pre-speech synchrony was greater in controls than patients, especially those with severe hallucinations. A 50 ms delay between pressing and hearing normalized N1 suppression in patients. EEG synchrony preceding speech reflects corollary discharge action, dampening auditory responsiveness to self-generated speech and is deficient in patients, especially hallucinators. Corollary discharge in patients may travel too slowly to suppress sensory experience.

SOUND PROCESSING IN SINGING CRICKETS

James Poulet
Max Delbrück Center for Molecular Medicine (MDC)

Male crickets stridulate or "sing" at over 100dB SPL to attract females and to warn off rival males. Remarkably, singing males are able to hear sounds in the environment despite generating such a loud song. In this talk, I will describe how they achieve this feat of sensory processing. While the responsiveness of the crickets' peripheral auditory system (tympanic membrane, tympanic nerve) is fully maintained during sound production, central auditory neurons are inhibited by an identified intersegmental corollary discharge interneuron. The inhibition is precisely timed to coincide with the auditory neurons' maximum response to self-generated sound and prevents desensitisation of the auditory pathway. This explains how singing crickets do not deafen themselves.

COROLLARY DISCHARGE CIRCUITS FOR STABILIZING VISUAL PERCEPTION

Marc A. Sommer
University of Pittsburgh

A mystery in psychology is why we perceive the visual world as continuous and stable, as if it were a movie. This is surprising because retinal input to the brain is more like a slideshow: images jump with every saccadic eye movement. An influential hypothesis is that the jumpy retinal input is tamed in the central visual system by combining it with predictive information about saccades, or corollary discharge. I am testing this hypothesis with neurophysiological methods in the primate brain. I found that a major saccade generating station in the brainstem, the superior colliculus, sends corollary discharge of saccades up to a high-level visual area, the frontal eye field (Sommer & Wurtz, 2008). Recording from the pathway revealed that it conveys information about when and where the next saccade will go, and inactivating the pathway demonstrated that it is needed for behaviors and neuronal operations that use corollary discharge (Sommer & Wurtz, 2002, 2006). Many neurons in the frontal eye field perform sophisticated operations that require advanced warning about saccades made in any direction, a paradox given that most neurons in frontal eye field (as in most of cerebral cortex) have been thought to receive information about events in contralateral space only. We resolved this paradox by showing that each frontal eye field receives input from both superior colliculi (Crapse & Sommer, 2009). The crossed pathway complements the same-side pathway to provide single frontal eye field neurons with information about all of visual and movement space.

THE ROLE OF THE HUMAN THALAMUS IN RELAYING SACCADE RELATED COROLLARY DISCHARGE SIGNALS

Christian Bellebaum, Klaus-Peter Hoffmann, Benno Koch, Michael Schwarz, & Irene Daum
Ruhr-University Bochum

The representation of visual space needs to be updated with every saccade. Work in monkeys has identified a pathway from the superior colliculus through the thalamus to the frontal eye field in which saccade-related corollary discharge information is relayed. In study 1 it was investigated, whether the thalamus has a similar function in humans. Patients with selective thalamic lesions were examined with a saccadic double step task. Pronounced deficits in programming two successive saccades were observed in patients with lesions affecting the ventrolateral thalamic nucleus, when the first saccade was directed contralateral to the lesion. Study 2 reported in this talk dealt with the timing of the updating process in the posterior parietal cortex, using event-related potentials (ERPs) and source-analysis techniques in healthy human subjects. The results suggest that updating takes place in the inter-saccade interval, when saccade sequences are performed. The updating ERP-component appears to reflect the integration of information about the first saccade with planning of the second saccade. Study 3 combined the approaches of studies 1 and 2 focussing on cortical processing during the performance of saccade sequences in thalamic lesion patients. Patients with behavioural updating deficits also showed changes in size or topography of the updating-related ERP-component.

Symposium 3.2

NEURAL MECHANISMS OF MEMORY CONTROL

Chair: Johanna Kissler, University of Konstanz

For adaptive functioning in daily life relevant items have to be continuously selected from the vast number of memories stored in our minds. In recent years, scientific attention has been drawn to the role of (possibly inhibitory) control mechanisms operational at encoding and retrieval that serve to reduce interference between different memories (e.g. Levy & Anderson, 2002). This symposium addresses the novel question of how such episodic memory control is accomplished by the brain. Across different paradigms such as retrieval-induced forgetting (Wimber), the Think/No Think task (Hanslmayr; Waldhauser) and directed forgetting (Hauswald; Bradley) the common and differential processes sub-serving automatic (retrieval-induced forgetting) and voluntary (Think-No Think Task; directed forgetting) memory control will be explored. Moreover, modification of memory control processes by emotional material will be addressed (Hauswald; Bradley) and related to both neural and peripheral physiology measures. Together, the presented studies point to the role of attentional orienting for both memory enhancement and suppression and suggest an interaction of distinct parietal and frontal brain structures in orchestrating these processes. Furthermore, presumably because of their immediate attention-demanding power, at least highly arousing emotional stimuli seem to be exempt from the influence of memory control processes. With its five contributions, the symposium brings together different topical aspects of research on memory control and intends to inspire new research in the area.