Ideally, evaluation of sexual interests and deviancy would be based on objective measures. The studies presented in this symposium aimed at finding neurobiological markers of sexual arousal and deviancy. Electroencephalography (EEG), neuro-imaging (fMRI), and neuropsychological original data will be presented in an attempt to better understand and assess sexual arousal and sexual offenders. The first study recruited men from the general population to show that accessible and low-cost EEG could be used to prove sexual arousal and interest, based on mirror cell activation. The second talk of this symposium focusses on the understudied neurology of juvenile sex offenders (JSO). Based on resting state analyses, this study suggests that connectivity between crucial cortical nodes is different in JSO compared to that of non-offender controls. Finally, the third talk will present fMRI and neuropsychological data obtained with pedophile men and healthy controls. As hypothesized, deficits in brain structural integrity, socio-emotional processing, and response inhibition were found in pedophiles, but mostly for those only, who sexually abused children. Differences found between offending and non-offending pedophiles, thus represent risk factors that need to be addressed in treatment approaches aimed at reducing the risk of hands-on delinquency in pedophiles. Overall, these original neuroscience data could have implications at both theoretical and clinical levels in the evaluation and understanding of sexual offenders.
Back to the Future: Evaluating Sexual Arousal with Good-Old EEG

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Background: The most objective measure of sexual preference certainly involves brain activation. Neuroimaging, however, is costly, lowly accessible, and relatively difficult to conduct. Objective. The goal of this study was to evaluate the feasibility of using quantitative (q) EEG to assess sexual arousal in a non-clinical sample. Given that both Ponseti et al (2006) and Mouras et al (2008) reported cortical activation associated with the mirror cells (inferior fronto-parietal regions) during exposition to erotic material in men, a more direct measure with qEEG might be useful. Method. A 32 active electrode system (Acticap and ActiChamp, Brain Vision) coupled with a plethysmograph (Limestone Technology) and an eyetracker (Tobii TX 300) were used to measure brain activation while viewing a pornographic clip. A total of 41 adult men participated in the study, and 35 of them obtained a significant erection. Spectral decomposition with FFT were performed to test the hypothesis that Alpha wave (8-13 Hz) would be significantly suppressed (activation of mirror cells) during sexual arousal as evidenced by erection and eye gaze. The pornographic clip was a five minute montage (five scenes with different sexual behaviors) of HD footage filmed with the first person perspective (more arousing). In order to control for Alpha suppression provoked simply by eye opening, positive emotions, or movement observation, three other conditions were included: i) opening the eyes and staring at a fixation neutral stimulus on the screen; ii) viewing a humorous number from a non-moving stand-up comic (5 min); viewing a long-haired men performing the same nonsexual movements (teeth brushing, mashing potatoes, etc) with the same pace (1 Hz), and the same view angle (also first person perspective, also 5 min), as in the porn movie (fellatio, masturbation, etc.). Measures were took at the usual central (C3-C4) and postero-central (P3-P4) cites, but also in 01-02 (occipital) to control for generalized Alpha suppression.

Results. As hypothesised by Ponseti et al (2006) and Mouras et al (2008), sexual arousal was associated with a strong depression of Alpha waves in central sites, associated with activation of the mirror cells. Interestingly, voltage maps showed that the suppression was highest in the postero-central cites. Significant alpha suppression was also observed in the occipital cites, but to a much less extent. A region X hemisphere interaction also indicated higher central alpha suppression in the right hemisphere, while the occipital alpha suppression was higher in the left hemisphere. Conclusion. The data concord with the association between sexual arousal and right hemisphere involvement. They suggest that alpha wave modulation recorded in postero-central cites, especially at P4, might be a good
objective neurobiological marker of sexual arousal, at least in right-handed men. Future studies should evaluate this marker in forensic populations.

Goals of the Paper:
1. Realizing that EEG might be useful to assess sexual arousal with objective data.
2. Learning what quantitative EEG and analyses of brain waves are.
3. Linking sexual arousal assessment and evaluation of sexual deviance or preference.

Functional Correlates of Adolescent Sexual Offending: A Resting State Analysis

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Despite increased interest in the role of neurological markers in individuals who engage in sexually inappropriate behaviors, there remains a paucity of research elucidating the neural correlates of sexually offending, particularly in the case of juveniles. Recent findings indicate, for instance, that although neuropsychological functioning is a meaningful marker of adult-perpetrated sexual offenses, juveniles with sexual behavior problems do not differ from non-sex-delinquents in this domain. Thus, the purpose of this study was to elucidate the functional correlates of juvenile sexual offending using resting state functional connectivity. The anterior cingulate cortex (ACC) and inferior frontal gyrus (IFG) were selected as seed regions. These regions have been associated with social cognition (i.e., ACC) and effortful control (i.e., IFG). It was hypothesized that juveniles who sexually offend (JSOs) would present differences in resting state connectivity between these regions and other parts of the brain when compared with non-sex-offenders.

A total of 53 males (ages 12-20) were enrolled. Participants were interviewed to assess their histories of sexual offending and current psychological functioning, and then underwent a 3T fMRI scan, during which resting state data were obtained. Results indicate greater connectivity between ACC and inferior parietal lobule and postcentral gyrus in JSOs vs. lower connectivity between IFG and right inferior parietal lobule and IFG and right precuneus when compared to non-offending juveniles (controls). These results contribute to our knowledge of the neural mechanisms associated with juvenile sexual offending, and may facilitate the development of effective tailored interventions to prevent CSA.
Goals of the Paper:
1. Discuss current research related to the neuropsychological and neurophysiological correlates of sexually offending.
2. Summarize the findings of a research study that uses functional neuroimaging (fMRI) to explore the brain-behavior relationships of sexual offending behaviors in male juveniles.
3. Discuss the implications for practice and future research related to the use of neuroimaging in the assessment and treatment of juveniles who sexually offend.

Neuropsychological and Neuronal Correlates of Pedophilia and/or Child Sexual Abuse

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Furthering our understanding of the mechanisms that cause or maintain sexual offending against children is a priority. Still much has to be learned about the neuropsychological and neurofunctional/structural underpinnings of pedophilia and/or child sexual abuse (CSA) in general. Recent studies displayed very inconsistent results. Most likely, methodological limitations and inconsistencies like the assessment of small study populations or the fact that different clinical entities were assessed under the same label of pedophilia, might be responsible for these heterogeneous findings.

Utilizing the assessment of multi-methodological neuroimaging techniques, the German multi-site research network NeMUP-North examines the (neuro)biological mechanisms underlying pedophilia and CSA on the basis of a specific study design, which allows us to differentiate between sexual preference and sexual behavior in a large sample of pedophiles with (P+CSA; N=50) and without (P-CSA; N=50) a history of sexual abusive behavior against children. On the one hand, we will demonstrate recent findings of CSA-related deficits in brain structural integrity, on the other hand we will provide evidence of distinct cognitive processing across a range of functional assessments associated with (a) morality and (b) response inhibition (task related fMRI), (c) self-referential abilities (resting-state functional connectivity) as well as (d) executive functioning (behavioral assessments). More specifically, comparing healthy controls (HC) with non-offending and offending pedophiles, our results point to a significant pattern of aberrant neuro-structural/functional integration in the latter group between brain areas, critically involved in a broad range of motivational and socio-emotional processes. Moreover, child
sexual abusers were found to exhibit decreased behavioral performances in neuropsychological assessments related to impulsivity when compared to P-CSA and HCs. Taken together, the present findings extend existing knowledge related to the neurobiological basis of pedophilia and CSA, identifying delinquent sexual behavior to be related to deficiencies in a widespread range of neurobiological and neuropsychological domains.

Goals of the Paper:
1. Providing insights into our recent research projects, where we primarily assess for the neuropsychological and neurophysiological correlates of pedophilia and child sexual abuse.
2. Conveying the advantages of analyzing task related fMRI, structural MRI as well as the resting brain with regard to sexual deviance or sexual offending. For instance, with regard to the latter, subjects are not demanded to perform on a specific task, so there is not much space for the influence of subject-based disturbances, for example the intention to disguise the own sexual preference, or the problem of intellectual differences between subjects.
3. Discussing the findings as well as the limitations of the present study within the framework of recent results deriving from experiments focusing on the functional and structural brain correlates of deviant sexual behavior.