

## **Computer-Generated Sexual Stimuli, Virtual Immersion and the Neurobiology of Self-Regulation in Pedophiles**

Symposium Chair: Patrice Renaud, Ph.D.

Virtual reality and related simulation technologies might change the way we do research and clinical practice with sex offenders in the near future. Assessment of sexual preferences and of other dimensions of sexual aggression such as self-regulation processes can be addressed through virtual reality (VR). For instance, VR could be used to track cognitive distortions and planning process of sexual aggression; daily life situations, elements of relapse cycle and stressing events can be simulated in VR to probe into these aspects of sexual aggression as if they were lived in real-time. In this way, emotional regulation problems, cognitive distortions and social difficulties could be addressed in context, either in isolation or in complex interactions. Furthermore, the coupling of this kind of VR-based methodology to neurofeedback and real-time brain-computer interface might well give rise to new therapeutics for deviant sexual behavior in the emerging field of neurorehabilitation. Realistic computer-generated sexual stimuli (CGS) are central to all these uses of VR in the field of sexual aggression research and clinical practice. CGS design needs to be simultaneously highly flexible to address idiosyncracies and in accordance to anthropometric and developmental standards, such as Tanner's stages.

Our symposium comprises three presentations in line with what precedes. First, Dr. Carla Harenski from the Mind Research Network will present on the neurobiology of self-regulation in pedophiles. More specifically, they will report on data about anatomical MRI scans and functional MRI scans of tasks assessing response inhibition, moral judgment, and facial expression processing from a sample of pedophiles and non-pedophiles. They will also address the use of animated CGS in their research program. Dr. Joanne-L. Rouleau, our second presenter, will present results coming from studies using virtual immersion, CGS, penile plethysmography (PPG) and attention control technologies in the assessment of sexual preferences in child molesters. She will also present data about voluntary erectile inhibition, especially on how oculomotor and perceptual-motor patterns may reveal concealing strategies. Finally, Dr. Jean-Pierre Guay will report preliminary results on the validation of emotionally expressive CGS used to measure recognition of facial expressions among individuals varying along dimensions of psychopathy. He will also discuss how VR and CGS could be used with sex offenders, especially in the case of rapists that generally display higher levels of psychopathy.

## **Cognitive, Affective, and Social Neuroscience of Pedophilia**

Carla Harenski, Ph.D.

Kent A. Kiehl, Ph.D.

Several neuroimaging studies conducted over the past decade have begun to shed light on the brain mechanisms underlying pedophilia. The majority of these studies have focused on brain responses to images of children and adults. While attraction to children is the core pathology of pedophilia, pedophiles also show abnormalities in other aspects of cognitive and affective processing which have received less attention, especially with regard to brain function. We will present the results of functional magnetic resonance imaging (fMRI) studies examining brain responses associated with response inhibition/error monitoring, facial expression processing, and moral judgment in pedophiles, non-pedophile sexual offenders, and healthy controls.

We used a mobile MRI scanner to scan pedophiles and non-pedophile sexual offenders committed to a secure treatment facility, and a group of matched healthy controls. Offenders and controls were scanned while completing the following tasks: 1. a response inhibition/error monitoring task in which they were required to withhold responses to an infrequent stimulus, 2. A facial expression task in which they made male/female classifications of faces depicting angry and neutral expressions, 3. A moral judgment task in which they viewed unpleasant images that did or did not depict moral transgressions, and rated their 'moral violation severity' on a 0-5 scale.

The results of these studies show that, in comparison to non-pedophiles, pedophiles show: 1. higher 'false alarm' rates in the inhibition task coupled with reduced hemodynamic responses in the anterior cingulate cortex and anterior insula, 2. Greater hemodynamic responses in the anterior insula and reduced responses in the inferior frontal gyrus when viewing angry relative to neutral facial expressions, and 3. Reduced hemodynamic responses across the entire 'moral neural network' (brain regions consistently implicated in moral judgment).

In addition to these fMRI studies, we will report preliminary results of an fMRI study in which pedophiles and non-pedophiles were scanned while viewing a novel set of animated nude child/adult stimuli. The goal of this research is to improve the overall characterization of aberrant brain function in pedophilia.

## **Computer-Generated-Stimuli, Eye-Tracking and Virtual Immersion: Toward New Assessment Methods of Child Molesters**

Joanne-L. Rouleau, Ph.D.

Mathieu Goyette, Ph.D.

Dominique Trottier, Ph.D.

Patrice Renaud, Ph.D.

Although sexual recidivism rates are lower than previously evaluated by researchers (Helmus, Hanson, Thornton, Babchishin, & Harris, 2012), the negative and severe impacts of these offenses justifies exploring new technologies so as to improve our efficiency, managing sex offenders. Authors of recent meta-analysis, Hanson, R. K., & Morton-Bourgon, K. E. 2005, 2009) have demonstrated the importance of deviant sexual interest as the best predictor of recidivism.

Sexuality has only been introduced in the last decade in the perspective of virtual reality, (Laws, 2004; Optale, 2004; Renaud, 2001, 2004, 2002, 2005, 2006, 2011, Trottier et al 2013). Yet it is a very promising tool to address problems related to human sexuality. In this presentation the focus will be on the assessment of deviant sexual interest. We will begin to present a comparison between Computer Generated Stimuli (CGS) and Audio Stimuli on PPG Assessment of 26 Child Molesters and 42 Controls. Second, we will describe the impact on Prediction Accuracy in the classification of Child Molesters, adding Eye-Tracking measures, compared to only using CGS and PPG. Then we will present the results of assessing sexual interest of Child Molester using CGS in immersive Virtual Reality. Finally we will present a study relying on Eye Tracking Devices to identify faking attempts during PPG assessments done with CGS (N=20).

From the first study results show that a specific profile of genital arousal emerges for Child Molester using Computer Generated Stimuli (CGS). However the classification accuracy obtained from Audio and CGS does not differ significantly. When Gaze Behavior patterns obtained using Eye-Tracking Devices are combined with PPG, the classification accuracy significantly improves, compared to the use of PPG only. Furthermore, a specific Gaze Behavior profile is observed for the Child Molesters on CGS compared to the Control Group. Computer-Generated Stimuli in Virtual Reality generated: sexual arousal profiles representative of sexual interests and deviance differentials indicative of sexual interests. Furthermore, compared to Audio Stimuli, Computer-Generated Stimuli in Virtual Reality allowed significantly higher classification accuracy as well as statistically superior discriminant validity. Finally, the use of Eye tracking during PPG assessment could improve the internal validity of the procedure by allowing the detection of faking attempts associated with visual avoidance as well as with specific scanpath patterns displayed while voluntarily inhibiting sexual arousal.

These results and the adaptability and plasticity of CGS justify a gradual implementation of these new technologies for the assessment of deviant sexual interests.

## Facial Affect Recognition: An Exploratory Approach with Animated Synthetic Characters

Jean-Pierre Guay, Ph.D.

Marie Cigna, M.A.

Patrice Renaud, Ph.D.

Emotions play an important role in social decisions. Even though pictures of facial expressions of emotions are increasingly being used in research on emotional information processing, the existing classic sets (Ekman & Friesen, 1976) are rather scarce and possess several methodological weaknesses. The aim of the present study was to develop more flexible ways to assess facial expression recognition in immersive virtual environments. More specifically, the objectives were: 1) to increase ecological validity in studies of facial recognition, by comparing the set of avatars we have created with the empirically validated Pictures of Facial Affect (POFA), and 2) to understand the relationship between psychological characteristics (i.e. psychopathy) and emotional information processing using dynamic emotions in a community sample. In the first part of our study, we used static stimuli displaying the six basic emotions at two intensity levels. Emotional content of 84 avatars and 48 pictures of the POFA was evaluated by 150 undergraduate students. In the second part, we measured recognition of facial expressions with animated characters in a sample of 134 undergraduate students, emotions being displayed at three intensity levels and angles. The data suggests that our affective stimuli are accurately identified by the participants. The ability to identify facial expressions of emotions is similar to the POFA and the results reported in previous studies. The results lend empirical support for the validity of our set of facial expressions, which possesses distinguishing attributes and is of particular utility in regard to emotion research. Results also highlight the influence of the distinct facets of psychopathy in facial affect recognition. The results suggested that individuals with high levels of criminal tendencies, measured by the SRP-III-R12, show deficits in facial affect recognition. Further, callous affect was associated with a better ability to recognize emotions, particularly sadness. In addition of being in colours, our stimuli are dynamic, diversified both on emotional content and ethnic representation and are displayed at different intensity levels. Further use of the set with sex offenders will be discussed, especially in the case of rapists that generally display higher levels of psychopathy.