ORIGINAL RESEARCH—PARAPHILIAS

Diminished Functional Connectivity on the Road to Child Sexual Abuse in Pedophilia

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ABSTRACT

Background. Pedophilia is a disorder recognized for its impairment to the individual and for the harm it may cause to others. However, the neurobiology of pedophilia and a possible propensity to sexually abuse children are not well understood. In this study, we thus aimed at providing new insights in how functional integration of brain regions may relate to pedophilia or child sexual abuse (CSA).

Method. By using functional magnetic resonance imaging (fMRI) technique, we compared functional connectivity at rest (RSFC) between pedophiles who engaged (P+CSA; N = 12) or did not engage (P–CSA; N = 14) in CSA and healthy controls (HCs; N = 14) within two networks: (i) the default mode network and (ii) the limbic network that has been linked to pedophilia before.

Results. Pedophiles who engaged in CSA show diminished RSFC in both networks compared with HC and P–CSA. Most importantly, they showed diminished RSFC between the left amygdala and orbitofrontal as well as anterior prefrontal regions. Though significant age differences between groups could not be avoided, correlation control analysis did not provide evidence for the assumption that the RSFC effects were related to age differences.

Conclusion. We found significantly diminished RSFC in brain networks critically involved in widespread motivational and socio-emotional processes. These results extend existing models of the functional neuroanatomy of pedophilia and CSA as altered RSFC between these regions were related to CSA rather than pedophilia and thus may account for an increased propensity to engage in CSA in people suffering from pedophilia. **Kärgel C, Massau C, Weiß S, Walter M, Kruger THC, and Schiffer B. Diminished functional connectivity on the road to child sexual abuse in pedophilia. J Sex Med 2015;12:783–795.**

Key Words. Pedophilia; Child Sexual Abuse; Resting-State; Functional Connectivity; Regional Homogeneity; fMRI; Default Mode Network

Introduction

Child sexual abuse (CSA) is a topic with a high amount of emotional public concern. Despite that pedophilia is thought to be the most important risk factor for engaging in sexual offences against children, it is neither a necessary nor a sufficient condition to account for CSA [1].

In pedophilia, consistency in findings regarding its neural underpinnings is rather small. However, previous studies suggested aberrant functionality in a network including frontocortical and limbic areas. In particular, altered activity in the orbitofrontal cortex (OFC), dorsolateral prefrontal cortex (PFC), as well as the anterior cingulate cortex (ACC) were reported in pedophilic offenders relative to controls during the processing of

sexually preferred stimuli [2–5]. Further evidence is supporting the hypothesis that pedophilia is linked to prefrontal disturbances derived from studies on brain morphometry [6–8], glucose metabolism [9], or neuropsychology [10,11]. Moreover, prior studies also suggested medial temporal deficiencies in offending pedophiles, particularly in the amygdala [12,13]. Cantor et al. [14] suggested pedophilia related white matter deficiencies in areas connecting limbic and prefrontal regions.

Taken together, these findings advert to a neural model of temporofrontal dysfunction (i.e., the limbic network) associated with deviant sexual arousal (SA) and/or behavioral disinhibition in pedophilia as already proposed by Cohen et al. [9]. Nevertheless, the consistency of findings within the small number of previous imaging studies in pedophilia is rather small and most likely caused by the fact that different clinical entities were assessed under the same label, pedophilia. The specificity of findings for pedophilia is thus completely unclear, as almost all findings may relate to CSA rather than pedophilia.

Based on the idea of distributed locations involved in the processing of SA, the assessment of neurobiological abnormalities in paraphilic populations could benefit from taking into account the functional connectivity among these structures. In this regard, a promising approach might be the analysis of the spontaneous low frequency fluctuations (<0.1 Hz) seen in the resting brain. These have been described as showing a high temporal synchronicity to regions widely distributed across the brain and were found to be organized in specific neuronal networks. One of the most investigated networks has been defined as the default mode network (DMN) [15], which comprises the ventral and dorsomedial PFC (including the OFC), posterior cingulate cortex (PCC), ACC, retrosplenial cortex, precuneus, hippocampal formation, temporo-parietal junction, inferior parietal lobule, and the temporal cortex.

With particular focus on the PCC–OFC connectivity, the functional significance of the DMN has been linked to a stimulus unspecific basis of a neural "self" in terms of self-referential mental activity or self-focused attention [16]. During these processes, the individual can be engaged in prospection, retrospection, shifting the immediate present to alternative perspectives, as well as in conceiving the (emotional) viewpoint of others [17]. Particularly, the latter aspect has also termed "theory of mind" (ToM), which can moreover be described as the ability allowing us to judge social consequences of own behaviors or those of others [18]. Although such deficits have frequently been related to schizophrenia [19] and autism [20], the investigation of the ToM concept was suggested to be of particular importance in the understanding of cognitive, affective and interpersonal difficulties underlying sexual offending [21]. ToM abilities are essential for adequate social interactions and were previously reported to be deficient in sexual offenders with adult victims [22] as well as in sexual child offenders [21,23]. Not astonishing, the neuronal underpinnings of ToM have been found to be disrupted in populations showing antisocial behavior [24]. Furthermore, deficient OFC functionality has been related to psychiatric conditions such as attention deficit hyperactivity disorder [25] and obsessive–compulsive disorder [26], indicating this region to be functionally related to impulsive or disinhibited behaviors.

This study aimed at providing new insights in how functional integration of brain regions may relate to pedophilia and/or CSA. By using resting-state functional magnetic resonance imaging (rsfMRI) technique, we compared functional connectivity (RSFC) within two networks between pedophiles who engaged (P+CSA) or did not engage (P–CSA) in CSA and healthy controls (HCs): (i) the DMN and (ii) the limbic network that has been linked to pedophilia before. We used seed regions-of-interest in the bilateral amygdala (limbic network) and the bilateral PCC (DMN). Based on the literature described above, we expected CSA-related rather than pedophilia-related RSFC alterations. In particular, we hypothesized diminished PCC–PFC connectivity as well as diminished amygdala-PFC RSFC in P+CSA as compared with P–CSA. Additionally, measures of short-distance connectivity were carried out by using regional homogeneity (ReHo) analysis, which is based on the proposition of synchronized metabolic activity within a functional brain area [27]. In this way, between group differences regarding the functional coherence of a given voxel with its nearest neighbors was investigated.

Methods

Participants

Twenty-six male participants who met criteria for pedophilia according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR) [28], and 14 male HCs were included in the present study (Table 1). Pedophiles without a history of CSA (N = 14) were exclusively recruited