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LETTER TO THE EDITOR

White Matter Volumes in Pedophiles, Hebephiles, and Teleiophiles

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Introduction

Structural magnetic resonance imaging (MRI) of the brain is increasingly being used to investigate possible neuroanatomic correlates of the various erotic age-preferences. Five such preferences are commonly distinguished in adult subjects, according to the category of persons who are most attractive sexually to the subject: pedophilia (prepubertal children in Tanner Stage 1, generally age 10 or younger), hebephilia (early pubertal children in Tanner Stages 2 and 3, generally ages 11 through 14), ephebophilia (late pubertal adolescents in Tanner Stage 4, generally ages 15 and 16), teleiophilia (adults in Tanner Stage 5, between the ages of physical maturity and physical decline), and gerontophilia (the elderly).

Three MRI-based studies of pedophilic patient samples have been published to date. Schiffer et al. (2007) analyzed 18 patients and 24 healthy, non-offender controls, hypothesizing differences in frontal and OCD-related brain structures. They applied small volume correction to the hypothesized structures and identified differences in the ventral striatum and nucleus accumbens, orbitofrontal cortex, and cerebellum. Schiltz et al. (2007) similarly analyzed 15 patients and 15 non-offender controls, but hypothesizing differences in the amygdala and other subcortical grey matter structures already associated with sexual behavior in non-human animals. Applying small volume correction to those structures, they found differences in the amygdala, hypothalamus, substantia innominata, septal region, and bed nucleus of the stria terminalis. Finally, our own team analyzed 65 patients and 62 men who committed nonsexual offenses (Cantor et al., 2008). This sample was large enough to permit a statistically non-biased analysis of the entire brain, rather than requiring focus on pre-selected brain structures. This revealed widespread differences in white matter regions in the parietal and temporal lobes (specifically, the superior fronto-occipital fasciculus, bilaterally, and the right arcuate fasciculus). This pattern of results was consistent with the conclusion that the various grey matter structures are related to the propensity to break the law, whereas the white matter deficits are related to pedophilia itself.

The sexual interests of pedophiles and hebephiles are not sharply delineated, and there exists one apparently transitional type—called *pedohebephiles* by Freund, Seeley, Marshall, and Glinfort (1972)—whose sexual interests span prepubescent and pubescent children. The similarity in the sexual preferences of pedophiles and hebephiles is accompanied by similarities in their neuropsychological profiles. A variety of findings suggests that neurodevelopmental perturbations in utero or during early childhood increase the risk of pedophilia (e.g., Cantor, Blanchard, Robichaud, & Christensen, 2005). For several relevant variables, hebephiles have produced means intermediate between those for pedophiles and those for teleiophiles (Blanchard et al., 2003, 2007; Cantor, Klassen et al., 2005; Cantor et al., 2004, 2006, 2007).

The present study compared pedophiles, hebephiles, and teleiophiles on targeted MRI variables. We reanalyzed the data archived from our original study (Cantor et al., 2008), which used a definition of pedophilia similar to that in the *International Classification of Diseases* (ICD-10): "A sexual preference for children, boys or girls or both, usually of prepubertal or early pubertal age" (World Health Organization, 1992, 2006). We therefore expected that it would be possible to reassign subjects to separate pedophilic and hebephilic groups.

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Method

Subjects

The research was conducted on the data archived from the 127 subjects originally reported in Cantor et al. (2008). The subjects included sexual offenders recruited from the Kurt Freund Laboratory of the Centre for Addiction and Mental Health, a specialty clinic in Toronto, Ontario for the assessment of paraphilias, and men with nonsexual offenses recruited from federal and provincial parole and probation offices in and around Toronto. No attempt was made to separate subjects by source of recruitment in the present reanalysis; they were treated as a single subject pool and classified into groups on other grounds, as described later. The mean age of the 115 subjects selected for the present study was 36.88 years ($SD = 11.82$), and the mean years of education was 12.05 ($SD = 2.95$).

Measures

Sexual History

A standardized form, described in detail by Blanchard et al. (2009), was used to record the subject's history of sexual offenses. Most of that information came from objective documents that accompanied his referral, for example, reports from probation and parole officers. The offense-history data were cross-checked against, and supplemented by, two other kinds of information provided by the subject himself. The first of these was the number and nature of any additional sexual offenses that were admitted by the subject but for which he was never charged. The second was his number of consenting adult sexual partners, including prostitutes. The subject's information was solicited in a structured sexual history interview.

Self-Reported Erotic Gender-Age Preferences

An interviewer at the Kurt Freund Laboratory also recorded the subject's self-reported sexual interest in other persons, using 12 separate variables: the subject's degree of sexual interest in females age 5 or younger, 6-10, 11, 12-14, 15-16, and 17 or older, and in males in the same six age-ranges. The interviewer quantified the subject's self-reported sexual interest in each of the 12 gender-age categories, using a rating from 1 to 5.

Phallometric Measurement of Erotic Gender-Age Preferences

Psychophysiological assessment consisted of phallometric testing, a procedure for assessing erotic interests in male adults and adolescents. In this procedure, the examinee's penile blood volume is monitored while he is presented with a standardized set of laboratory stimuli depicting a variety of potentially erotic activities or objects. The examinee's penile blood volume increases (i.e., degrees of penile erection) are taken as an index of his relative attraction to the different classes of stimuli.

The specific test used in this study has been described in detail by Blanchard, Klassen, Dickey, Kuban, and Blak (2001). Additional information about the stimulus materials has been reported by Blanchard et al. (2007, 2009). The test stimuli are audiotaped narratives presented through headphones and accompanied by slides. There are seven categories of narratives, which describe sexual interactions with prepubescent girls, pubescent girls, adult women, prepubescent boys, pubescent boys, and adult men, and also solitary, nonsexual activities ("neutral" stimuli). The accompanying slides show nude models corresponding in age and sex to the topic of the narrative. Neutral narratives are accompanied by slides of landscapes. The time required to complete a test is usually about 1 h. An elaborate process of data reduction, which is outlined by Blanchard et al. (2001), yields seven category scores, which summarize the subject's penile responses to stimuli in the different categories; these are taken as measures of his relative erotic interest in adult women, pubescent girls, and so on.

There were 20 subjects for whom phallometric testing was not done or was not usable. The great majority of these were men with nonsexual offenses, because phallometric testing was not conducted on such men at the beginning of the study. These subjects were not automatically excluded from the study but rather were evaluated for possible group assignment on other grounds, as described shortly.

Data Acquisition and Quantification of Temporal and Parietal White Matter Volumes

The data acquisition and image processing methods are detailed in our original report (Cantor et al., 2008, p. 170). Briefly, MR images were acquired with a 1.5T MRI system (G.E., Milwaukee, WI) located at the Toronto General Hospital (Toronto, Canada), using a three-dimensional, inversion-prepped, radio-frequency fast spoiled-gradient recalled-echo (IR-FSPGR) sequence (TI = 300 ms, TR = 12 ms, TE = 5 ms, flip angle = 20°, FOV = 20 cm, matrix = 256 × 256 pixels). This yielded 124 continuous 1.5 mm thick coronal sections. After tissue classification, white matter images underwent Automated Nonlinear Image Matching and Anatomical Labeling (ANIMAL) (Collins, Holmes, Peters, & Evans, 1995).

For this reanalysis, the only parameters of brain anatomy of interest were those that were significantly associated with pedophilia originally: the white matter volumes in the temporal and parietal lobes. To reduce the number of dependent variables even further, we combined data from the two hemispheres, so that the only two variables of key interest were bilateral temporal white matter volume and bilateral parietal white matter volume.

Results

In the first phase of data analysis, patients were divided into three discrete groups. The basis of this classification was phallometric data, with self-report data used as alternative, and offense-history data as confirmatory, sources of information. The classification rules were essentially identical to those used by Blanchard et al. (2003, p. 577).

A patient was classified as pedophilic if he responded more, on the phallometric test, to prepubescent boys or girls than he did to persons in any other gender-age category, or if he lacked a valid phallometric test but stated that he was more attracted to boys or girls age 10 or younger than he was to persons in any other gender-age category.

A patient was, similarly, classified as hebephilic if he responded more to pubescents than he did to prepubescent or adult persons, or if he lacked a valid phallometric test but stated that he was more attracted to boys or girls age 11 through 14 than to younger or older persons.

The classification of a patient as teleiophilic was made more stringent by the addition of a second criterion. This was done because teleiophilia is the socially and psycholegally desirable diagnosis, and many pedo- and hebephilic patients endeavor, both in interview and in their phallometric testing, to obtain it (see Blanchard et al., 2001). The first criterion was that the patient responded more, on the phallometric test, to adult men or women than he did to persons in any other gender-age category, or else he lacked a valid phallometric test but stated that he was more attracted to persons past their 17th birthday than to younger persons. The second, confirmatory criterion was that the patient lacked any history that might contradict his phallometric results or self-report, specifically, any known sexual offenses against male or female victims under the age of 17.

There were 12 patients who could not be classified according to the foregoing rules. Of the remaining 115, 19 were classified as pedophiles, 49 as hebephiles, and 47 as teleiophiles. There was no significant difference between groups in mean age or in years of education, both Fs < 1.

Figure 1 shows, for each group, the sum of white matter volumes in the right and left temporal lobes and the sum of white matter volumes in the right and left parietal lobes. A simple ANOVA (SPSS-20) with no covariates revealed that between-groups differences in temporal white matter volume were significant, $F(2, 112) = 3.31$, $p = .04$. Repeated contrasts showed that there was no difference between the pedophilic and hebephilic groups, $p = .80$, and that the hebephilic group had a significantly lower volume of white matter in the temporal lobes than did the teleiophilic group, $p = .02$.[1]

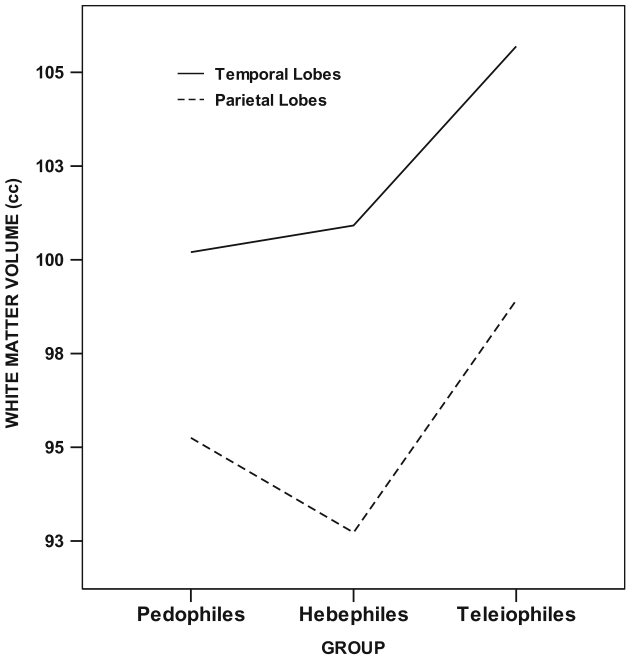

Fig. 1 Cubic centimetres of white matter in the temporal lobes bilaterally and parietal lobes bilaterally, by erotic age preference group ($n = 19$ pedophiles, 49 hebephiles, and 47 teleiophiles)

A similar ANOVA found that between-groups differences in parietal white matter volume approached significance, $F(2, 112) = 2.91$, $p = .06$. Repeated contrasts again showed that there was no difference between the pedophilic and hebephilic groups, $p = .46$, and that the hebephilic group had a significantly lower volume of white matter in the parietal lobes than did the teleiophilic group, $p = .02$.

Discussion

There has not yet been, to our knowledge, any attempt to replicate the white matter findings originally reported in Cantor et al. (2008). If those original findings should prove unreliable, then the present reanalysis of the same dataset would also need to be disregarded. In the meantime, one can speculate about the implications of the present findings if they are true.

The finding that the neuroanatomy of hebephiles resembles that of pedophiles more closely than that of teleiophiles either is or is not surprising, depending on which other factors one takes into consideration. On the one hand, previous studies using neuropsychological variables like IQ or related variables such as school failure (Cantor et al., 2006) could suggest that hebephiles are intermediate and in some sense "equidistant" from pedophiles and teleiophiles (e.g., Blanchard et al., 2007). On the other hand, children in Tanner Stages 2 and 3—the preferred sexual objects of hebephiles—might be perceived as physically more similar to children in the later years of Tanner Stage 1 than to fully mature individuals (Tanner Stage 5) by the average human observer.

[1] In repeated contrasts, each level of a factor is compared to the previous level. Thus, the number of possible contrasts is one less than the number of groups.

If that is true, then one might expect hebephiles to be more similar to pedophiles than to teleiophiles on relevant neuroanatomic parameters.

New imaging technologies, such as Diffusion Tensor Imaging (DTI), have been developed that provide additional information about white matter anatomy. Such developments—in combination with larger samples of individuals with a diverse range of erotic age-preferences—may yet demonstrate that hebephiles differ neuroanatomically from pedophiles as well as from teleiophiles. Because the neuroanatomic correlates of erotic age-preferences are now gaining wider research interest, this question could be addressed in the foreseeable future.

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