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Retrospective Self-Reports of Childhood Accidents Causing Unconsciousness in Phallometrically Diagnosed Pedophiles

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The present study investigated whether head injuries in childhood might increase the risk of pedophilia in males. The subjects were 1206 patients referred to a clinical sexology service for assessment of their erotic preferences. These were classified, on the basis of phallometric test results, as pedophilic ($n = 413$) or nonpedophilic ($n = 793$). Information regarding early head injuries, other signs of possible neurodevelopmental problems, and parental histories of psychiatric treatment were collected with self-administered questionnaires. The results showed that childhood accidents that resulted in unconsciousness were associated with pedophilia and with lower levels of intelligence and education. These associations were statistically significant for accidents that occurred before the age of 6, but not for accidents that occurred between the ages of 6 and 12. These results are compatible with the hypothesis that neurodevelopmental perturbations in early childhood may increase the risk of pedophilia. They are also, however, compatible with the alternative explanation that prior neurodevelopmental problems lead to accident-proneness and head injury, on the one hand, and to pedophilia, on the other, and that head injury has no causal influence on pedophilia. A secondary finding was that the pedophiles were more likely to report that their mothers had undergone psychiatric treatment. This finding suggests that pedophilia may be influenced by genetic factors, which are manifested in women as an increased risk of psychiatric problems, and in their sons, as an increased risk of erotic interest in children.

KEY WORDS: childhood accidents; head injury; neuropsychology; pedophilia; phallometry; sex offenders.

INTRODUCTION

The term *pedophilia* denotes the erotic orientation of individuals (usually men) whose sexual interest in prepubescent children exceeds their sexual interest in physically mature adults (Freund, 1981). Most clinical authorities differentiate between true pedophiles versus men who, despite an erotic preference for the mature physique, have molested children in particular circumstances, for example, while they were intoxicated (Barbaree & Seto, 1997).

Several studies have examined the cognitive neuropsychological functioning of sex offenders against children (less often, homogeneous groups of diagnosed pedophiles), using a variety of nonpedophilic control groups. The most frequently assessed neuropsychological characteristic has been general intelligence or IQ. Some investigators have compared sex offenders against children with noncriminal community control groups, finding the sex offenders to score lower in intelligence (Langevin et al., 1985). Other investigators have compared sex offenders against children with men convicted of nonsexual crimes, thus controlling for their status in the legal system and any antisociality. The offenders against children again scored

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lower (Hambridge, 1994; Hucker et al., 1988; Langevin, Wortzman, Dickey, Wright, & Handy, 1988; Langevin, Wortzman, Wright, & Handy, 1989). Still other investigators have compared sex offenders against children with sex offenders against adults, thus controlling not only for legal status but also for the demonstration of sexually atypical behavior. Once again, the offenders against children scored lower (Blanchard et al., 1999; Ellis, 1951; Frosh & Bromberg, 1939; Henn, Herjanic, & Vanderpearl, 1976; Quinsey, Arnold, & Pruesse, 1980).

Similar conclusions have been reached by investigators who used the Halstead-Reitan and Luria-Nebraska Neuropsychological Batteries and who found that sex offenders against children showed greater impairment than offenders committing nonsexual crimes (Scott, Cole, McKay, Golden, & Liggett, 1984) and offenders committing sexual crimes against adult women (Hucker et al., 1986; Langevin et al., 1988, 1989). Many of the foregoing studies had one or more methodological weakness and the occasional comparison produced inconsistent results; however, the bulk of evidence indicates that pedophiles show poorer cognitive functioning in comparison with any reasonable control group.

Another neuropsychological variable that is routinely included in clinical neuropsychological assessments is hand-preference. Two studies have assessed the relation between this variable and pedophilia. Bogaert (2001) found that pedophiles have elevated rates of left-handedness. Cantor, Christensen, Klassen, Dickey, and Blanchard (2001) confirmed this relation and showed that it remained significant when they controlled for IQ. Although this is not the main reason we introduce the handedness findings in this paper—our purpose is explained below—it should be noted that these findings argue against the notion that any observed neuropsychological differences between pedophiles and their comparison groups are likely to be mere artifacts of ascertainment bias. This is relevant because the previously reviewed findings on pedophilia and IQ could conceivably be interpreted as such artifacts: Less intelligent pedophiles are more likely to be apprehended (or be unable to afford the best lawyers); therefore convicted pedophiles will have lower mean IQs. One might plausibly argue that less intelligent pedophiles are more likely to be apprehended, but one cannot plausibly argue that left-handed pedophiles are more likely to be apprehended.

The present significance of the handedness findings and the IQ findings lies in the information they provide about neurodevelopment. A variety of research has shown that perturbations in neurodevelopment can lead to deficits in cognitive functioning. Data from human studies that support this observation can be gleaned from several sources. First, acquired neurologic damage during infancy or early childhood has profound and long-lasting cognitive effects. This has been demonstrated among children with brain tumors (Radcliffe, Bunin, Sutton, Goldwein, & Phillips, 1994), traumatic brain injury (Taylor et al., 1999), intracranial hemorrhage (Dennis & Barnes, 1994), perinatal hypoxia (Gottfried, 1973), and epilepsy (Neyens, Aldenkamp, & Meinardi, 1999). Second, exposure to neurotoxic substances, either in utero or early in postnatal development, can have similar robust effects on cognition. Such effects have been associated with several teratogenic substances including lead (Needleman, Schell, Bellinger, Leviton, & Allred, 1990), coumarins (Wesseling et al., 2001), alcohol (Olson, Feldman, Streissguth, Sampson, & Bookstein, 1998), and tobacco (Frydman, 1996). Third, genetic disorders, with known adverse neurobiological effects, have also been connected with low cognitive functioning. For example, children with fragile X syndrome (Fisch et al., 1996), velocardiofacial syndrome (Kozma, 1998), and Down's syndrome (Hayes & Batshaw, 1993) typically demonstrate significant intellectual impairment. Considered collectively, the foregoing studies strongly suggest that a variety of adverse neurodevelopmental events/conditions can lead to poor intellectual functioning.

Another line of research has shown that perturbed neurodevelopment increases the probability of left-handedness (Coren & Halpern, 1991). Typically, these studies have found that rates of left-handedness are elevated among individuals exposed to pre- or perinatal neurodevelopmental disruptions. Examples of neurodevelopmental risk factors include a variety of events and conditions: prenatal exposure to neurotoxins (Biro & Stukovsky, 1995), ultrasound (Kieler, Cnattingius, Haglund, Palmgren, & Axelsson, 2001), extremely low birth weight (Saigal, Rosenbaum, Szatmari, & Hoult, 1992), twin births (Coren, 1994), prematurity (Marlow, Roberts, & Cooke, 1989), and markers of birth stress (Williams, Buss, & Eskenazi, 1992).

The fact that pedophilia is associated with left-handedness and with poor cognitive functioning, two variables that are causally related to neurodevelopmental perturbation, suggests that pedophilia may also be causally related to neurodevelopmental perturbation. It is possible, in other words, to obtain correlations among pedophilia, left-handedness, and poor cognitive functioning, because neurodevelopmental problems predispose a male to develop all three.

Neurodevelopment is not complete at birth. It continues throughout childhood and, in certain regards, up to and during adulthood. Neurodevelopment can be broadly divided into two phases (Lund, 1997). During the first

phase, which occurs prenatally in most mammals, new neurons are formed (neurogenesis), move to their correct positions (neuronal migration), and elaborate the primary neuritic elements that constitute emerging dendritic fields (Caviness, 1989). The formation of new synapses is also central to this phase (Lewis, 1997). During the second phase, which occurs both pre- and postnatally, the fine details of neuronal structure and the organization of circuitry are accomplished via cell death, axonal pruning, and synaptic elimination (Caviness, 1989). In addition, environmental sensory modulation of synaptic connectivity occurs (Lund, 1997).

Although much of the second phase is completed in the first few postnatal years, there are significant refinements in neuronal structure and brain circuitry during later periods of development. For example, the dentritic spines of pyramidal neurons in cortical layer III exhibit rapid attrition until approximately 4.5 years of age in the monkey (Anderson, Classey, Conde, Lund, & Lewis, 1995). Moreover, the density of axospinous synapses declines from approximately 3 years of age through adulthood and the density of GABAergic chandelier neurons declines from the age of 1.5 years to stable adult levels following puberty (Anderson et al., 1995). Similarly, several changes in several neurotransmitter systems extend into late postnatal development. Dopamine varicosities undergo a marked increase in density until the time of puberty (Plant, 1988) whereas the density of cholecystokinin neurons in Layers 1 and 3 steadily decline postnatally (Lund & Lewis, 1993). Additionally, studies utilizing structural neuroimaging methods (e.g., MRI) have demonstrated that morphometric brain changes continue well into adulthood (Jernigan & Sowell, 1997). For example, Pfefferbaum et al. (1994) found that overall brain growth persists until 10 years of age, gray matter volume increases until approximately 4 years of age, and white matter volume increases until around 20 years of age. In addition, there was some evidence for changes in sulcal volume until 30 years of age.

The sequelae of brain damage vary as a function of the developmental stage during which the injury occurred (Kolb, Gibb, & Gorny, 2000). This has been observed across several laboratory species including rats, cats, and monkeys (for reviews, see Almli & Finger, 1984; Finger & Almli, 1984). The question therefore arises as to the time frame during which neurodevelopmental perturbations could result in pedophilia.

One indication comes from research on handedness. Handedness appears to be determined during fetal development (e.g., Hepper, Shahidullah, & White, 1991). It follows that if the observed correlation between pedophilia and left-handedness is correctly attributed to neurodevelopmental perturbations that produced both, then those perturbations most likely occurred during the prenatal or perinatal period.

The possibility that neurodevelopmental problems before birth may increase a male's risk of pedophilia does not preclude the possibility that neurodevelopmental problems after birth may also increase the risk of pedophilia. In fact, our review of postnatal brain development indicates that the latter possibility is quite feasible. The present study was therefore conducted to look for evidence that might support it. We were interested, in particular, in the correlation between pedophilia and traumatic head injuries. Head injuries are certainly capable of affecting neurodevelopment and they are relatively accessible through patients' self-report. The finding of a positive correlation would, of course, have implications for the etiological theory of pedophilia. It would also, however, have implications for normal psychosexual development, in that it would suggest that at least one dimension of erotic object-choice—the age of the persons to whom a man is most attracted—is not completely determined before birth.

METHOD

Subjects

The Kurt Freund Laboratory (formerly, Research Section of Behavioural Sexology) of the Centre for Addiction and Mental Health in Toronto, Ontario, Canada, conducts sexological assessments on male patients referred because of illegal or disturbing sexual behavior. The centerpiece of these assessments is phallometric testing, a psychophysiological technique for assessing erotic interests in male adults and adolescents. In this procedure, the individual'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 patient'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 great majority of patients are referred to the Laboratory by parole and probation officers, lawyers, correctional institutions, children's protective societies, and so on, although some patients seek a referral on their own initiative.

During the years when he headed this service (1969–95), Kurt Freund, M.D., D.Sc. (deceased) gave versions of the same self-administered, paper-and-pencil questionnaire to virtually all patients capable of completing it (i.e., those with sufficient English-language skills and intellectual capacity). This questionnaire, the *Erotic Preferences Examination Scheme* (EPES) was never published in its

entirety, although scales composed of items from it have been published in a variety of places (e.g., Blanchard, 1989, 1998; Freund, 1981; Freund & Blanchard, 1983, 1998). Beginning with the last major revision of the EPES (1974) until its replacement with a different instrument (1995), the patients' responses to the EPES were archived in a computerized database, along with their phallometric test results.

The EPES included four items concerning childhood episodes of unconsciousness with or without obvious traumatic causes. The database was searched for all subjects who answered one or more of these items (over 99% of subjects who answered one of them answered all four), and who produced valid results on either of the two versions of the phallometric test most frequently used during this period for assessing patients' erotic interest in persons of different ages. These will be referred to as the "nine-category version" and the "five-category version," for reasons that will become clear later.

This retrieval extracted 1206 subjects. These had a mean age of 34.88 years ($SD = 11.68$). Subjects indicated their educational level on one item of the EPES by endorsing one of seven response-options, ranging from *no formal education* to *university graduation*. Their median educational level was more than 8 but fewer than 12 grades completed.

The known sex offenses involved prepubescent girls for 50% of the subjects, pubescent girls for 18%, adult women for 16%, prepubescent boys for 26%, pubescent boys for 33%, and adult men for 3%. These percentages add up to more than 100%, because some subjects had sex offenses in more than one category. There were 902 subjects who had valid results on the nine-category version of the phallometric test, and 304 subjects who did not have valid results on the nine-category version but did have valid results on the five-category version.

Materials and Procedure

Intelligence Rating

All subjects underwent a semistructured interview, which was conducted, in the great majority of cases, by Dr. Freund himself. In these interviews, standard pieces of information were collected for clinical purposes and for storage in the previously mentioned database. Of present interest was the interviewer's global impression of the patient's intelligence. This was based on the patient's personal, educational, and employment histories and his clinical presentation in interview, plus whatever other information was available (e.g., IQ test results, whether the patient was living in a group home for the mentally retarded, whether the patient travelled on his own to the interview or was brought by a parent or other caregiver, and so on). The recorded estimate employed a 6-point rating scale: 1 = *retarded*, 2 = *borderline retarded*, 3 = *dull normal*, 4 = *average*, 5 = *bright normal*, 6 = *superior intelligence*.

Basic Phallometric Procedure

The phallometric apparatus and the basic procedures used with this study's subjects are the same as those used in the Kurt Freund Laboratory today. This laboratory is equipped for volumetric plethysmography; that is, the apparatus measures penile blood volume change rather than penile circumference change. The volumetric method measures penile tumescence more accurately at low levels of response (Kuban, Barbaree, & Blanchard, 1999). The construction and operating principles of the volumetric equipment have previously been described in several places (e.g., Blanchard, Klassen, Dickey, Kuban, & Blak, 2001).

The examinee puts the volumetric sensor over his penis, according to instructions from the test administrator. He then sits in a reclining chair, which faces three adjacent projection screens (sometimes only one projection screen, in early subversions of the tests analyzed in this paper). After the set-up is complete, the examinee's lower body is covered with a sheet to minimize his embarrassment or discomfort. During the test, the examinee's face is monitored by a low-light video camera, in order to monitor stimulus avoidance strategies such as closing the eyes or averting them from the test stimuli.

The test stimuli are presented in discrete trials. Each trial presents stimuli from one and only one class, although several exemplars of that class (e.g., prepubescent boys) may be included in the same trial. The trials are arranged into blocks, with each block including one trial of each type in fixed pseudorandom order. Although the length of the trials is fixed, the interval between trials varies, because penile blood volume must return to its baseline (flaccid) value before a new trial is started. The time required to complete a test is usually about 1 hr.

Recording of penile blood volume begins 5 s before trial onset and ends 5 s after trial offset. The pre- and posttrial data are not, however, used in any computations; therefore the trial response does not reflect recovery (i.e., detumescence) rates.

Penile blood volume change is sampled four times per second. The examinee's response is quantified in two ways: as the extremum of the curve of blood volume change (i.e., the greatest departure from initial value occurring during the trial), and as the area under the curve. To

identify examinees whose penile blood volume changes during the test trials remain within the range typical of random blood volume fluctuations in nonaroused subjects, the mean of the three highest positive extremum scores—a quantity called the *Output Index* (Freund, 1967)—is calculated. In the present study, the phallometric data of subjects who failed to meet a criterion output index of 1.0 cm^3—the criterion currently used in the Laboratory—were excluded as invalid.

Each examinee's extremum scores are then converted into standard scores, based only on his own extremum data, and the same operation is carried out on his area scores. Next, for each examinee, the standardized extremum and area scores are combined to yield a separate composite score for each of the trials, using the formula $(z_i^E + z_i^A)/2$, where z_i^E is the standardized extremum score for the ith trial and z_i^A is the standardized area score for the ith trial. These operations are carried out for the following reasons

(a) In phallometric work, some transformation of raw scores is generally required in combining data from different examinees, because the interindividual variability in absolute magnitude of blood volume changes can otherwise obscure even quite reliable statistical effects. There are numerous sources of such variability, for example, the examinee's age, his state of health, the size of his penis, and the amount of time since his last ejaculation from masturbation or interpersonal sexual activity. Empirical research has shown the z-score transformation to be optimal (Earls, Quinsey, & Castonguay, 1987; Harris, Rice, Quinsey, Chaplin, & Earls, 1992; Langevin, 1985).

(b) The (highly correlated) area and extremum z-scores are averaged to obtain a composite that reflects both the speed and amplitude of response and lessens the impact of anomalous responses, that is, large change from initial value but small area or vice versa (Freund, Scher, & Hucker, 1983).

In the last stage of basic processing, the data are reduced to a set of final scores for each examinee by averaging his composite scores in each of the stimulus categories. These *category scores* are taken as measures of the examinee's relative erotic interest in adult women, pubescent girls, prepubescent girls, and so on.

Nine-Category Test Version

The specific features of the nine- and five-category test versions have previously been described, and data from them have previously been published (e.g., Freund & Blanchard, 1989; Freund & Watson, 1991). Those studies were concerned with the accuracy of the phallometric test in diagnosing pedophilia, and none of them examined the variables of interest in the present study.

In this version of the test, the stimuli were 28-s film clips of nude adults or children smiling and walking slowly toward the camera (but not engaging in any overtly sexual or even flirtatious behavior). These stimuli included eight categories of human types: physically mature women, pubescent girls, 9–11-year-old girls, and 5–8-year-old girls, and four corresponding categories of males. The ninth stimulus category ("neutral") consisted of film clips of landscapes (waves crashing on a beach, etc.), with no human beings in evidence. The test consisted of three blocks of nine trials. Following the general procedure described earlier, each block included one trial of each type in fixed pseudorandom order.

Five-Category Test Version

This differed from the nine-category version in the modality of the test stimuli as well as the number of different stimulus categories. The stimuli were audiotaped narratives presented through headphones and accompanied by slides shown on projection screens. There were five categories of narratives, which described sexual interactions with prepubescent girls, adult women, prepubescent boys, and adult men, and also solitary, nonsexual activities ("neutral" stimuli). All narratives were written in the second person and present tense (e.g., "You are babysitting a five-year-old girl for the evening. She is taking a bath before she gets ready for bed. Through the open bathroom door, she calls you to come in and scrub her back . . .") and were approximately 100 words long.

The narratives describing heterosexual interactions were recorded with a woman's voice, and those describing homosexual interactions, with a man's. Neutral stimuli were recorded with both. Each test trial consisted of one narrative, accompanied by photographic slides that showed nude models corresponding in age and gender to the topic of the narrative. Neutral narratives were accompanied by slides of landscapes. The test consisted of five blocks of five trials, with each trial being 54 s long.

RESULTS

Subjects were dichotomously classified as pedophilic or not pedophilic according to one of two similar rules, depending on which version of the phallometric test they had

undergone. Subjects who had the nine-category test were classified as pedophilic if their penile response to any of the four child stimulus categories (girls 5–8, girls 9–11, boys 5–8, boys 9–11) was greater than their response to both adult women and adult men. Subjects who had the five-category test were classified as pedophilic if their penile response to either prepubescent girls or prepubescent boys was greater than their response to both adult women and adult men. Subjects who did not meet the foregoing criteria were classified, by default, as not pedophilic. Very similar proportions of subjects were classified as pedophilic by the two tests: 33.5 and 36.5%, for the nine- and five-category tests, respectively.

Figure 1 shows the mean response profiles for the 302 pedophilic and 600 nonpedophilic subjects diagnosed with the nine-category phallometric test, and Figure 2 shows the profiles for the 111 pedophilic and 193 nonpedophilic subjects diagnosed with the five-category test. Because these are *z*-transformed data, 0.00 on the *Y*-axis represents the grand mean of responses to all stimulus categories, not the absence of erotic response. The absence of erotic response is located by the mean response to the neutral stimulus category. These figures show that the nonpedophilic subjects primarily responded to adult women on the phallometric test. These data are consistent with the breakdown of known sex offenses given earlier, which indicated that relatively few patients in this sample were referred because of sexual behavior involving adult men.

Table I shows the responses of pedophilic and nonpedophilic subjects to the EPES questionnaire item, "Before you were age 6, did you ever have an accident which left you unconscious for at least half an hour?" The sample size is 899 rather than 902 for the nine-category subjects because 3 subjects with the nine-category test did not answer this item. The table shows that among the subjects who had the nine-category test, 10.6% of the pedophilic subjects indicated that they had experienced an accident resulting in unconsciousness before age 6, compared with 4.5% of the nonpedophilic subjects. The results of a chi-square test comparing these proportions, which are presented in the table notes, indicate that the difference was statistically significant. The corresponding percentages for the subjects who had the five-category test were 9.0 and 4.1%. Although these results are similar to those for the subjects with the other phallometric test, they did not quite reach statistical significance in the (two-tailed) chi-square test ($p = .08$), probably because the sample size was much

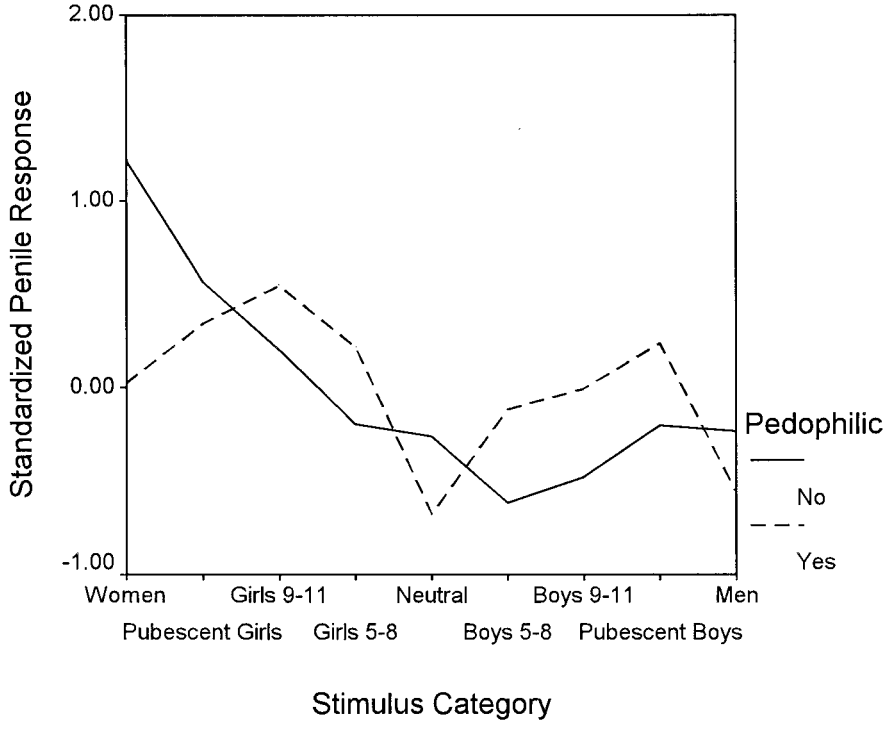

Fig. 1. Mean response profiles for the 302 pedophilic and 600 nonpedophilic subjects diagnosed with the nine-category phallometric test. The pedophiles are represented by the broken line, and the nonpedophiles are represented by the solid line. Higher standardized scores signify greater penile responses.

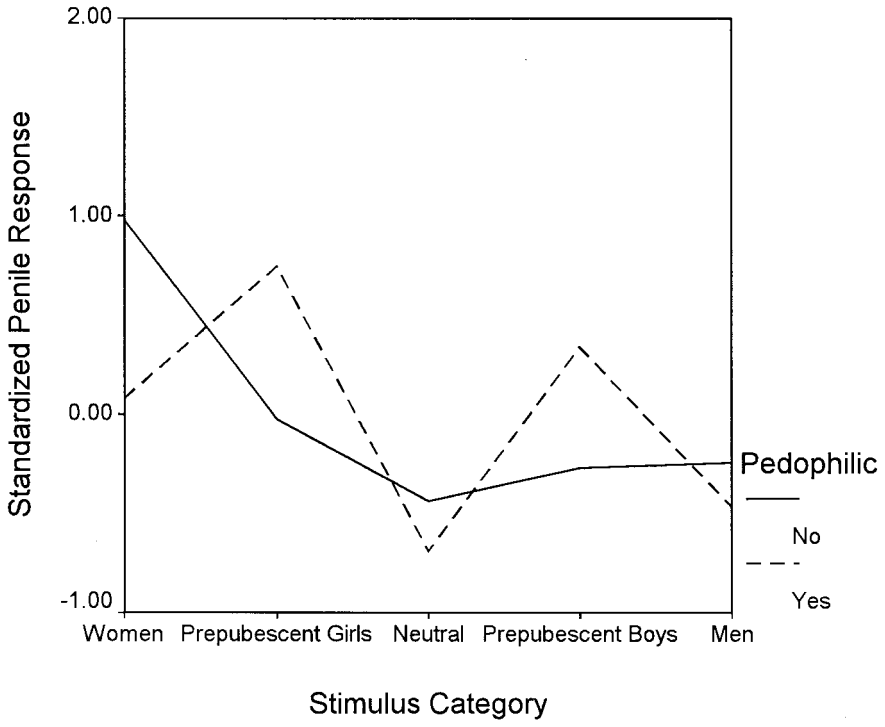

Fig. 2. Mean response profiles for the 111 pedophilic and 193 nonpedophilic subjects diagnosed with the five-category phallometric test. The pedophiles are represented by the broken line, and the nonpedophiles are represented by the solid line. Higher standardized scores signify greater penile responses.

smaller. In the combined group of all subjects, 10.2% of pedophiles and 4.4% of nonpedophiles reported an accident before age 6 that left them unconscious. The difference was statistically significant.

Table I. Questionnaire Item: "Before you were age 6, did you ever have an accident which left you unconscious for at least half an hour?"

	Phallometric test diagnosis			
	Pedophilic		Not pedophilic	
Response-option	*n*	%	*n*	%
Subjects with nine-category test[a]				
"Yes"	32	10.6	27	4.5
"No or don't know"	269	89.4	571	95.5
Subjects with five-category test[b]				
"Yes"	10	9.0	8	4.1
"No or don't know"	101	91.0	185	95.9
All subjects[c]				
"Yes"	42	10.2	35	4.4
"No or don't know"	370	89.8	756	95.6

Note. Numbers and percentages of pedophilic and nonpedophilic subjects who endorsed each response-option.
[a] $\chi^2(1, N = 899) = 12.21, p < .001$.
[b] $\chi^2(1, N = 304) = 2.99, p = .08$.
[c] $\chi^2(1, N = 1203) = 15.05, p < .001$.

Subjects' responses to the questionnaire item, "Between the ages of 6 and 12, did you ever have an accident which left you unconscious for at least half an hour?" are shown in Table II. In this case, the percentages of pedophiles and nonpedophiles responding in the affirmative differed significantly for the five-category group (9.9 and 4.1%, respectively), but not for the nine-category group. The difference was also significant for the combined sample.

Table III presents the results for a third, composite variable: Whether the subject responded "Yes" to either of the previously mentioned items—in other words, whether the subject ever had an accident resulting in unconsciousness prior to age 13. Positive histories were significantly associated with pedophilia in subjects with both phallometric tests and in the combined group.

In Tables IV and V are presented the results for the questionnaire items, "Before you were age 6, was there a period when you blacked out frequently for no apparent (external) reason?" and "Between the ages of 6 and 12, was there a period when you blacked out frequently for no apparent (external) reason?" Table VI shows the results for the composite variable: Whether the subject responded "Yes" to either of the preceding items—that is, whether the subject ever experienced a period with frequent losses

Table II. Questionnaire Item: "Between the ages of 6 and 12, did you ever have an accident which left you unconscious for at least half an hour?"

	Phallometric test diagnosis			
	Pedophilic		Not pedophilic	
Response-option	*n*	%	*n*	%
Subjects with nine-category test[a]				
"Yes"	34	11.3	51	8.5
"No or don't know"	267	88.7	548	91.5
Subjects with five-category test[b]				
"Yes"	11	9.9	8	4.1
"No or don't know"	100	90.1	185	95.9
All subjects[c]				
"Yes"	45	10.9	59	7.4
"No or don't know"	367	89.1	733	92.6

Note. Numbers and percentages of pedophilic and nonpedophilic subjects who endorsed each response-option.
[a] $\chi^2(1, N = 900) = 1.81$, $p = .18$.
[b] $\chi^2(1, N = 304) = 4.00$, $p = .05$.
[c] $\chi^2(1, N = 1204) = 4.14$, $p = .04$.

of consciousness prior to age 13. Hardly any subjects reported such a history prior to age 6, and the somewhat greater number of subjects who reported this between ages 6 and 12 were about equally likely to be pedophiles or nonpedophiles. None of the statistical comparisons for these three variables was statistically significant.

The analyses for the four items that we initially targeted did not strongly suggest that the findings for childhood accidents occurred because the pedophiles were, for some unknown reason, prone to claim pathology of all types, or because the pedophiles answered this section of the questionnaire carelessly, checking the first response-option of each item regardless of its content. (For all four items, the first response option was "yes" and the second was "no or don't know.") Nevertheless, we decided to look further for evidence of such response biases.

The section of the EPES that contained the four items regarding childhood unconsciousness included four other

Table III. Composite Variable: Did the subject have any accident resulting in unconsciousness prior to age 13?

	Phallometric test diagnosis			
	Pedophilic		Not pedophilic	
Composite response	*n*	%	*n*	%
Subjects with nine-category test[a]				
Yes	54	17.9	70	11.7
No	248	82.1	530	88.3
Subjects with five-category test[b]				
Yes	17	15.3	13	6.7
No	94	84.7	180	93.3
All subjects[c]				
Yes	71	17.2	83	10.5
No	342	82.8	710	89.5

Note. Numbers and percentages of subjects who reported at least one experience before age 6, between ages 6 and 12, or in both age ranges.
[a] $\chi^2(1, N = 902) = 6.54$, $p = .01$.
[b] $\chi^2(1, N = 304) = 5.83$, $p = .02$.
[c] $\chi^2(1, N = 1206) = 11.03$, $p = .001$.

Table IV. Questionnaire Item: "Before you were age 6, was there a period when you blacked out frequently for no apparent (external) reason?"

	Phallometric test diagnosis			
	Pedophilic		Not pedophilic	
Response-option	*n*	%	*n*	%
Subjects with nine-category test[a]				
"Yes"	5	1.7	12	2.0
"No or don't know"	295	98.3	587	98.0
Subjects with five-category test[b]				
"Yes"	1	0.9	2	1.0
"No or don't know"	110	99.1	191	99.0
All subjects[c]				
"Yes"	6	1.5	14	1.8
"No or don't know"	405	98.5	778	98.2

Note. Numbers and percentages of pedophilic and nonpedophilic subjects who endorsed each response-option.
[a] $\chi^2(1, N = 899) = 0.12$, $p = .73$.
[b] $\chi^2(1, N = 304) = 0.01$, $p = .91$.
[c] $\chi^2(1, N = 1203) = 0.16$, $p = .69$.

Table V. Questionnaire Item: "Between the ages of 6 and 12, was there a period when you blacked out frequently for no apparent (external) reason?"

	Phallometric test diagnosis			
	Pedophilic		Not pedophilic	
Response-option	*n*	%	*n*	%
Subjects with nine-category test[a]				
"Yes"	19	6.3	28	4.7
"No or don't know"	281	93.7	572	95.3
Subjects with five-category test[b]				
"Yes"	3	2.7	2	1.0
"No or don't know"	108	97.3	190	99.0
All subjects[c]				
"Yes"	22	5.4	30	3.8
"No or don't know"	389	94.6	762	96.2

Note. Numbers and percentages of pedophilic and nonpedophilic subjects who endorsed each response-option.
[a] $\chi^2(1, N = 900) = 1.12$, $p = .29$.
[b] $\chi^2(1, N = 303) = 1.20$, $p = .27$.
[c] $\chi^2(1, N = 1203) = 1.60$, $p = .21$.

Table VI. Composite Variable: Did the subject experience any period with frequent losses of consciousness prior to age 13?

	Phallometric test diagnosis			
	Pedophilic		Not pedophilic	
Composite response	*n*	%	*n*	%
Subjects with nine-category test[a]				
Yes	21	7.0	34	5.7
No	281	93.0	566	94.3
Subjects with five-category test[b]				
Yes	3	2.7	3	1.6
No	108	97.3	190	98.4
All subjects[c]				
Yes	24	5.8	37	4.7
No	389	94.2	756	95.3

Note. Numbers and percentages of subjects who reported at least one period before age 6, between ages 6 and 12, or in both age ranges.
[a] $\chi^2(1, N = 902) = 0.58, p = .45$.
[b] $\chi^2(1, N = 304) = 0.48, p = .49$.
[c] $\chi^2(1, N = 1206) = 0.74, p = .39$.

items that pertained, in a general way, to potential neurodevelopmental correlates of adult sexual behavior. Three of these preceded, and one followed, the four items on childhood unconsciousness. The first item was, "Has your own (natural) father ever had psychiatric treatment?" and the second was, "Has your own (natural) mother ever had psychiatric treatment?" These items had parallel response options: "yes," "no, or not sure," and "know little or nothing about your father [mother]." The third item was, "Do you know anything about your birth?" This item offered five response options: "you were born prematurely at seven or eight months with no further complications," "there were complications at birth, without premature birth," "there were complications at birth, with premature birth," "none of the above," and "haven't been told." The fourth item (which followed the unconsciousness items) asked, "When did you stop wetting your bed?" This item had six response options: "before age 4," "before age 12," "before age 15," "past age 15," "haven't stopped," and "don't know." We investigated these items to ascertain whether pedophiles were differentially prone to endorse first-listed response-options or pathology-claiming response-options.

None of the items concerning father's psychiatric history, obstetrical complications, or bed-wetting produced any statistically significant results. A summary of the findings for these variables is presented in Table VII.

The one variable that produced statistically significant results was the item concerning the mother's

Table VII. Questionnaire Items Concerning Father's Psychiatric History, Obstetrical Complications, and Bed-wetting

	Phallometric test diagnosis			
	Pedophilic		Not pedophilic	
Response-option	*n*	%	*n*	%
"Has your own (natural) father ever had psychiatric treatment?"[a]				
"Yes"	31	7.5	34	4.3
"No, or not sure"	314	76.4	633	80.0
"Know little or nothing about your father"	66	16.1	124	15.7
"Do you know anything about your birth?"[b]				
"You were born prematurely at seven or eight months with no further complications"	21	5.1	26	3.3
"There were complications at birth, without premature birth"	46	11.2	82	10.4
"There were complications at birth, with premature birth"	11	2.7	28	3.5
"None of the above"	182	44.2	391	49.6
"Haven't been told"	152	36.9	262	33.2
"When did you stop wetting your bed?"[c]				
"Before age 4"	155	37.5	305	38.7
"Before age 12"	103	24.9	199	25.3
"Before age 15"	29	7.0	56	7.1
"Past age 15"	10	2.4	22	2.8
"Haven't stopped"	5	1.2	5	0.6
"Don't know"	111	26.9	201	25.5

Note. Numbers and percentages of all pedophilic and nonpedophilic subjects who endorsed each response-option.
[a] $\chi^2(2, N = 1202) = 5.74, p = .06$.
[b] $\chi^2(4, N = 1201) = 5.75, p = .22$.
[c] $\chi^2(5, N = 1201) = 1.53, p = .91$.

Table VIII. Questionnaire Item: "Has your own (natural) mother ever had psychiatric treatment?"

	Phallometric test diagnosis			
	Pedophilic		Not pedophilic	
Response-option	*n*	%	*n*	%
Subjects with nine-category test[a]				
"Yes"	47	15.6	47	7.8
"No, or not sure"	232	77.1	498	83.0
"Know little or nothing about your mother"	22	7.3	55	9.2
Subjects with five-category test[b]				
"Yes"	10	9.0	8	4.1
"No, or not sure"	92	82.9	175	90.7
"Know little or nothing about your mother"	9	8.1	10	5.2
All subjects[c]				
"Yes"	57	13.8	55	6.9
"No, or not sure"	324	78.6	673	84.9
"Know little or nothing about your mother"	31	7.5	65	8.2

Note. Numbers and percentages of pedophilic and nonpedophilic subjects who endorsed each response-option.
[a] $\chi^2(2, N = 901) = 13.31, p = .001$.
[b] $\chi^2(2, N = 304) = 4.27, p = .12$.
[c] $\chi^2(2, N = 1205) = 15.31, p < .001$.

psychiatric history. The data are presented in Table VIII. The results, which suggest that the mothers of pedophiles were more likely to have undergone psychiatric treatment, were similar for the subjects with the nine- and five-category tests, but they were statistically significant only for the former, probably because of their larger sample size. The results were also statistically significant for the combined subjects.

The foregoing item was investigated more thoroughly with a logistic regression analysis, which used the combined group of all subjects. The criterion was the subject's phallometric diagnosis (coded "1" for pedophilic and "0" for not pedophilic). The predictors were dummy variables representing a set of Helmert contrasts. (This type of contrast is a standard option for various statistical procedures in numerous software packages. The present authors used SPSS, Version 10.1.) Our Helmert contrasts were designed for two comparisons: the subjects who responded "No, or not sure" versus those who responded "Know little or nothing about your mother"; and the subjects who responded "Yes" versus the other two groups combined. The results of this analysis are presented in Table IX.

In Table IX, each coefficient B represents the change in the log odds of pedophilia associated with the corresponding contrast. The next column presents the standard error (SE) for each B. The Wald statistic was the quantity used to determine the significance level (p) of each contrast. The quantity e^B is the multiplicative change in the odds of pedophilia for a given contrast, and thus $100 \times (e^B - 1)$ represents the percentage change in the odds for that contrast.

Table IX. Logistic Regression of Phallometric Diagnosis (Pedophilic or Not Pedophilic) on Mother's Treatment Item, Using Helmert Contrasts

Predictor (Helmert contrast)	*B*	*SE*	Wald	*p*	e^B
Yes vs. other response-options	0.77	0.22	12.20	<.001	2.16
No/not sure vs. know little/ nothing about mother	0.01	0.23	0.00	.97	1.01

Note. This analysis used the combined group of all subjects who answered mother's treatment item, $N = 1205$.

The results show that there was no difference in the odds of pedophilia between the subjects who endorsed the response-option "No, or not sure" and those who endorsed "Know little or nothing about your mother." However, those subjects who endorsed the "Yes" option, indicating that their mother had undergone psychiatric treatment, were over twice (i.e., 216%) as likely to be pedophilic as those subjects who endorsed one of the negative options ($e^B = 2.16$). This result was statistically significant.

In summary, the foregoing analyses did not provide evidence that the results for the childhood accident items were an artifact of response bias. They did, however, yield evidence that pedophilia might be related to maternal psychiatric disorders, in addition to whatever factors were reflected by the unconsciousness items.

The univariate analyses for the items regarding accidents before age 6 and accidents between 6 and 12 suggested that accidents in the earlier age range were more strongly associated with pedophilia. We investigated this further in another logistic regression analysis, in which the criterion variable was again the subject's phallometric diagnosis. The predictor variables were the two accident items, with the subjects' responses coded "1" for "Yes" and "0" for "No or don't know." The results of this multivariate analysis are presented in Table X.

In Table X, each coefficient B represents the change in the log odds of pedophilia associated with a "Yes" response to the corresponding item, controlling for the subject's response to the other item. The quantity e^B is the multiplicative change in the odds of pedophilia associated with a "Yes" response, and $100 \times (e^B - 1)$ represents the percentage change in the odds associated with a "Yes" response.

The results indicated that controlling for accidents at the later age, accidents at the earlier age more than doubled

Table X. Logistic Regression of Phallometric Diagnosis (Pedophilic or Not Pedophilic) on Subjects' Responses to Questionnaire Items Concerning Childhood Accidents

Predictor	*B*	*SE*	Wald	*p*	e^B
Accident causing unconsciousness before age 6	0.83	0.25	11.50	.001	2.30
Accident causing unconsciousness between 6 and 12	0.24	0.22	1.23	.27	1.27

Note. This analysis used the combined group of all subjects who answered both questionnaire items, $N = 1201$.

the odds of pedophilia ($e^B = 2.30$, that is, the odds increased 230%). This association was statistically significant. In contrast, accidents at the later age, controlling for accidents at the earlier age, did not significantly increase the odds of pedophilia.

The finding that pedophilia was associated with accidents in earlier rather than later childhood prompted us to investigate whether other signs of problematic neurodevelopment would also be associated, in this sample, with accidents in earlier rather than later childhood. To test this, we used two linear regression analyses. In one of these, the criterion variable was the previously described interviewer rating of the subject's intelligence, and in the other, the criterion variable was the subject's self-reported educational level. The predictor variables were the same in both analyses—accidents causing unconsciousness before age 6, and accidents causing unconsciousness between the ages of 6 and 12—coded as described above. These analyses were run on the subjects phallometrically diagnosed as pedophiles (on either test), on the subjects diagnosed as nonpedophiles, and on the combined group of all subjects. The results are given in Table XI.

The results were similar for the pedophiles and the nonpedophiles. They indicated that both lower intelligence and lesser educational achievement were more strongly associated with childhood accidents before age 6 than with childhood accidents between the ages of 6 and 12.

Finally, we examined the relations between the subject's intelligence rating and educational level, on the one hand, and his mother's history of psychiatric treatment, on the other. For this analysis, the subjects' responses to the maternal psychiatric treatment item were coded "1" for "Yes" and "0" for either of the two types of negative responses. There were 405 pedophiles and 791 nonpedophiles with complete data for mother's psychiatric history and subject's rated intelligence, and there were 410 pedophiles and 792 nonpedophiles with complete data for mother's psychiatric history and subject's education.

For the pedophiles, the correlations with maternal psychiatric treatment were $r = .03$ and .08 for intelligence and education respectively; for the nonpedophiles, they were .06 and .05; and for the combined subjects, they were .03 and .05. None of these correlations was statistically significant.

DISCUSSION

The present study found evidence that childhood accidents that produce unconsciousness are associated with

Table XI. Linear Regressions of Intelligence Rating and Education on Subjects' Responses to Questionnaire Items Concerning Childhood Accidents

Criterion	N^a	Predictor	β	*t*	*p*
Pedophiles					
Intelligence	404	Accident causing unconsciousness before 6	−0.12	−2.39	.02
		Accident causing unconsciousness between 6 and 12	−0.01	−0.19	.85
Education	409	Accident causing unconsciousness before 6	−0.09	−1.82	.07
		Accident causing unconsciousness between 6 and 12	−0.04	−0.72	.47
Non-pedophiles					
Intelligence	788	Accident causing unconsciousness before 6	−0.07	−2.02	.04
		Accident causing unconsciousness between 6 and 12	−0.05	−1.34	.18
Education	789	Accident causing unconsciousness before 6	−0.08	−2.12	.04
		Accident causing unconsciousness between 6 and 12	−0.05	−1.25	.21
All subjects					
Intelligence	1192	Accident causing unconsciousness before 6	−0.10	−3.44	.001
		Accident causing unconsciousness between 6 and 12	−0.04	−1.24	.22
Education	1198	Accident causing unconsciousness before 6	−0.09	−3.04	.002
		Accident causing unconsciousness between 6 and 12	−0.04	−1.49	.14

[a] Number of subjects with valid scores for the criterion variable and both predictor variables.

pedophilia and with lower levels of cognitive functioning. These associations were statistically significant for accidents that occurred before the age of 6, but not for accidents that occurred between the ages of 6 and 12. These results suggest that neurodevelopmental perturbations in early childhood might increase the risk of pedophilia. That would have the further implication that erotic age-preference is not fully determined in utero, and that later events can influence a man's relative attraction to adults versus children.

A secondary finding was that maternal history of psychiatric treatment—a reasonable proxy for the occurrence of psychiatric problems—was also associated with pedophilia. Maternal psychiatric history did not, however, correlate with lower levels of cognitive functioning. These results raise several possibilities. The first is that pedophilia may have multiple causes. That would make pedophilia analogous in one regard to homosexuality, for which the available evidence strongly suggests multiple causes (Blanchard, 2001; Blanchard et al., 2002; Blanchard & Ellis, 2001; Cantor, Blanchard, Paterson, & Bogaert, 2002). The second is that pedophilia may be influenced by genetic factors, which are manifested in women as an increased risk of psychiatric problems, and in their sons, as an increased risk of erotic interest in children. The third possibility is that different etiologic pathways to pedophilia may have different associated features. Thus, for example, men whose pedophilia was ultimately caused by a head injury may have lower levels of cognitive functioning—or perhaps a different pattern of cognitive deficits—than men whose pedophilia was largely determined in utero by genetic factors.

The obvious limitation of this study is the self-report nature of the childhood and family history information. There are at least two problems that must be considered under this heading. The first is that of literal accuracy. It is questionable whether all subjects who reported that before age 6, they experienced an accident that left them unconscious for at least half an hour had, in fact, been under age 6 when the accident occurred, had been left in a state that would meet clinical criteria of unconsciousness, and had remained in this state for 30 min or longer. It is also questionable whether the rate of head injuries reported (10.2% among the pedophiles) is reasonable and believable. The latter question is difficult to judge on general grounds. On the one hand, a rate over 10% seems extraordinarily, if not suspiciously, high in a group of patients who were not referred because of problems in reasoning, memory, motor skills, or similar complaints. On the other hand, a rate this high might not be excessive if pedophilia is itself a type of neurodevelopmental disorder. Therefore the plausibility of this absolute value can be decided only by examining other pedophilic samples. In summary, it is safer to interpret the patients' self-reports, not as historically accurate accounts of childhood head injuries, but rather as indications that the subject had some childhood injury involving a blow to the head—an injury serious enough for him to remember it directly or for it to have become part of family lore.

The question of literal accuracy is not critical for purposes of this study, provided that between-groups differences in self-report actually reflected between-groups differences in rates of head injury, and provided that intentional or unintentional distortions of the facts were roughly equal for the pedophilic and nonpedophilic groups. This, however, brings up the second problem: Did the pedophiles report more head injuries than the nonpedophiles because they truly had more head injuries, or rather because they were disposed to claim more head injuries? One might hypothesize that many pedophiles claimed head injuries that never occurred, or grossly exaggerated memorable but minor occurrences, as a way of diminishing responsibility for their sexual conduct toward children. This is a reasonable hypothesis, but there are equally reasonable arguments against it. The men in this study who were not phallometrically diagnosed as pedophiles also had actions to account for; a proportion of them had sexual offenses against adults, and another proportion had sexual offenses against children, even though they were not phallometrically diagnosed as pedophiles. Why should this group have felt significantly less motivated to explain or excuse their behavior?

Another argument against the hypothesis that the present results were simply artifacts of response bias is the finding that the phallometrically diagnosed pedophiles did not indiscriminately endorse all questionnaire items that suggested neurodevelopmental problems or family histories of psychiatric illness. Of the eight items we examined, they differentially endorsed only two: accidents with unconsciousness before age 6, and mother's history of psychiatric treatment.

At this point, the objection might be raised that two of eight items is what could be expected by chance. It should be noted that this is not an argument that the results were caused by response bias but rather an argument that there were no real results at all. This statistical argument is blunted by the fact that similar results were found in two independent samples. Also weighing against it is the fact that, of two head injury items with identical wording except for the timing of the injury, the pedophiles differentially endorsed the one that also correlated, in this sample, with lower intelligence and lesser education.

Another approach to assessing the general plausibility of the present data is to consider whether our finding that lower cognitive functioning correlates with head injuries in earlier rather than later childhood is consistent with other research. Unfortunately, researchers disagree regarding age of injury effects. It was once believed that perinatal or neonatal brain damage had milder consequences compared with later brain damage (e.g., Kennard, 1938). In contrast, current researchers often predict more positive outcomes for injuries sustained at later ages when neural connections are more mature. Empirical findings are conflicting, with studies to support either perspective (for reviews, see Aram & Eisele, 1992; Chapman & McKinnon, 2000). Additionally, differences in how researchers categorize age and define outcomes likely contribute to inconsistencies. For instance, although studies including both children and adults have linked earlier ages of injury with better language production outcomes (Bates et al., 2001) and global recovery rates (Overgaard et al., 1973), studies of pediatric populations have found that children injured at younger ages have worse semantic memory outcomes (Levin et al., 1996) and higher mortality rates (Mahoney et al., 1983). Studies have also reported that age of injury interacts with injury type (Bates et al., 2001; Chapman & McKinnon, 2000) and severity (Levin et al., 1996). Long-term follow-up studies are few, although one longitudinal study found that functioning was worst among those adults who had sustained head injuries in the earliest years of life (Koskiniemi, Kyykkä, Nybo, & Jarho, 1995). Thus, in the current state of knowledge, it is not possible to evaluate the likely validity of the present data by comparing them to definitive findings in the general literature on childhood head injuries.

There is, to sum up to this point, no way to eliminate response bias as a possible explanation of the present findings—the EPES questionnaire was simply not designed to address this type of issue—but there is also no compelling reason to regard response bias as the most likely explanation. We can therefore move on to consider what interpretations of the data are possible if pedophiles do, in fact, experience more head injuries before age 6.

The simplest and most obvious interpretation of such a relation is that childhood head injuries increase the risk of pedophilia. There is, however, at least one alternative interpretation that cannot be ruled out at this time: Some third variable—one that is chronologically and causally prior—both increases a boy's risk of pedophilia and also renders him prone to childhood accidents.

This type of relation is readily illustrated with an analogy. Childhood head injuries correlate with gender: Boys are more likely to sustain head injuries than are girls (e.g., Henry, Hauber, & Rice, 1992; Kraus & McArthur, 1996). It is clear that head injuries do not turn a child into a boy. A more reasonable explanation is that prenatal events that induce phenotypic masculinity (e.g., androgen exposure) also increase the child's activity level and thus increase the child's risk of getting into accidents.

In the present case, it is possible that neurodevelopmental perturbations in utero increase the individual's risk of pedophilia and also increase the risk of some behavioral or perceptual problem that leads to accident-proneness. One example of such a problem is attention deficit hyperactivity disorder (ADHD). Numerous studies have documented that children with ADHD have accident proneness and elevated rates of injuries (see Barkley, 1996, for review). The prevalence of premorbid ADHD and behavioral problems among children with head injuries is higher than that for control samples of children (Brown, Chadwick, Shaffer, Rutter, & Traub, 1981; Gerring et al., 1998), and, among children hospitalized for injuries, those with a premorbid diagnosis of ADHD are more likely to have sustained head injuries and to be severely injured compared to children without premorbid ADHD diagnoses (DiScala, Lescohier, Barthel, & Li, 1998). Thus, if pedophiles were to have elevated rates of ADHD, they would be expected to have greater rates of childhood head injuries than the general population. Figure 3 illustrates the two different models of the relation between childhood head injury and pedophilia: the first model, in which head injury causes pedophilia, and the second model, in which it does not.

It should be clear, from the foregoing discussion, that we regard the present study as preliminary in nature and largely heuristic in value. Its limitations with regard to neuropsychiatric assessment should not completely overshadow its strengths with regard to sexological assessment, namely, two large and nonoverlapping groups of phallometrically diagnosed patients. Satisfactory research in this area requires valid sexological assessment just as much as it requires valid neuropsychiatric or neurogenetic assessment, and the present research compares favorably with any previously published in the former regard. We therefore feel that this investigation provides ample justification for future studies specifically designed to elucidate the statistical association of pedophilia and childhood head injury. Clarifying the role of head injury is important for understanding the relation between neurodevelopment and pedophilia, even if that clarification means eliminating head injury as a possible cause of pedophilia. It should be noted that useful research in this area will require groups of substantial size. For example, to confirm our central

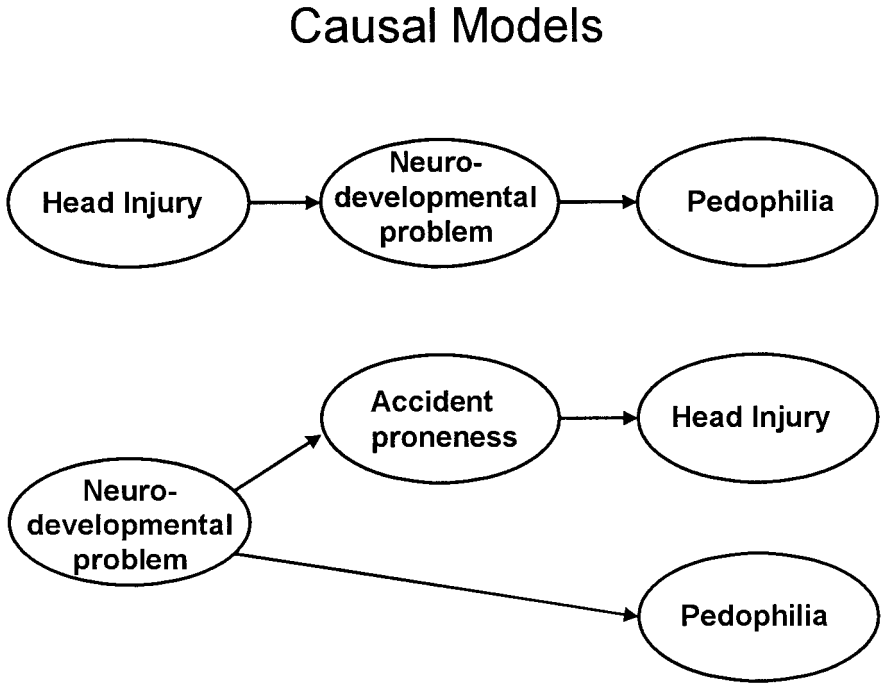

Fig. 3. Alternative models for explaining the observed correlation between childhood head injuries and pedophilia. In the first (i.e., upper) model, head injuries cause neurodevelopmental problems, which, in turn, increase the risk of pedophilia. In the second (i.e., lower) model, prior neurodevelopmental problems lead to accident-proneness and head injury, on the one hand, and to pedophilia, on the other. In this model, head injury has no causal influence on pedophilia.

finding (Table I) with a statistical power of 80% at $\alpha = .05$ two-tailed, a researcher would need a sample slightly over half the size of ours, that is, about 210 pedophiles and 420 nonpedophiles.

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REFERENCES

Almli, C. R., & Finger, S. (1984). *Early brain damage: Vol. 1. Research orientations and clinical observations*. New York: Academic Press.

Anderson, S. A., Classey, J. D., Conde, F., Lund, J. S., & Lewis, D. A. (1995). Synchronous development of pyramidal neuron dendritic spines and parvalbumin-immunoreactive chandelier neuron axon terminal in layer III of monkey prefrontal cortex. *Neuroscience, 67,* 7–22.

Aram, D. M., & Eisele, J. A. (1992). Plasticity and recovery of higher cognitive functions following early brain injury. In I. Rapin & S. J. Segalowitz (Eds.), *Handbook of neuropsychology* (Vol. 6, pp. 73–92). Amsterdam: Elsevier.

Barbaree, H. E., & Seto, M. C. (1997). Pedophilia: Assessment and treatment. In D. R. Laws & W. O'Donohue (Eds.), *Sexual deviance: Theory, assessment, and treatment* (pp. 175–193). New York: Guilford Press.

Barkley, R. A. (1996). Attention-deficit/hyperactivity disorder. In E. Mash & R. A. Barkley (Eds.), *Child psychopathology* (pp. 63–112). New York: Guilford Press.

Bates, E., Reilly, J., Wulfreck, B., Dronkers, N., Opie, M., Fenson, J., et al. (2001). Differential effects of unilateral lesions on language production in children and adults. *Brain and Language*, *79,* 223–265.

Biro, V., & Stukovsky, R. (1995). Handedness as manifested in school children from a region polluted by neurotoxins. *Studia Psychologica*, *37,* 81–87.

Blanchard, R. (1989). The concept of autogynephilia and the typology of male gender dysphoria. *Journal of Nervous and Mental Disease*, *177,* 616–623.

Blanchard, R. (1998). Cross-Gender Fetishism Scale. In C. M. Davis, W. L. Yarber, R. Bauserman, G. Schreer, & S. L. Davis (Eds.), *Handbook of sexuality-related measures* (pp. 581–582). Thousand Oaks, CA: Sage.

Blanchard, R. (2001). Fraternal birth order and the maternal immune hypothesis of male homosexuality. *Hormones and Behavior*, *40,* 105–114.

Blanchard, R., & Ellis, L. (2001). Birth weight, sexual orientation and the sex of preceding siblings. *Journal of Biosocial Science*, *33,* 451–467.

Blanchard, R., Klassen, P., Dickey, R., Kuban, M. E., & Blak, T. (2001). Sensitivity and specificity of the phallometric test for pedophilia in

nonadmitting sex offenders. *Psychological Assessment*, *13,* 118–126.

Blanchard, R., Watson, M. S., Choy, A., Dickey, R., Klassen, P., Kuban, M., et al. (1999). Pedophiles: Mental retardation, maternal age, and sexual orientation. *Archives of Sexual Behavior*, *28,* 111–127.

Blanchard, R., Zucker, K. J., Cavacas, A., Allin, S., Bradley, S. J., & Schachter, D. C. (2002). Fraternal birth order and birth weight in probably prehomosexual feminine boys. *Hormones and Behavior*, *41,* 321–327.

Bogaert, A. F. (2001). Handedness, criminality, and sexual offending. *Neuropsychologia*, *39,* 465–469.

Brown, G., Chadwick, O., Shaffer, D., Rutter, M., & Traub, M. (1981). A prospective study of children and head injuries: III. Psychiatric sequelae. *Psychological Medicine*, *11,* 63–78.

Cantor, J. M., Blanchard, R., Paterson, A. D., & Bogaert, A. F. (2002). How many gay men owe their sexual orientation to fraternal birth order? *Archives of Sexual Behavior*, *31,* 63–71.

Cantor, J. M., Christensen, B. K., Klassen, P. E., Dickey, R., & Blanchard, R. (2001, July). Neuropsychological functioning in pedophiles. In R. Blanchard (Chair), *Diagnosis, prognosis, and etiology of pedophilia.* Symposium conducted at the meeting of the International Academy of Sex Research, Bromont, Quebec.

Caviness, V. S. (1989). Normal development of cerebral neocortex. In P. Evrard & A. Minkowski (Eds.), *Developmental neurobiology* (pp. 1–10). New York: Raven Press.

Chapman, B. S., & McKinnon, L. (2000). Discussion of developmental plasticity: Factors affecting cognitive outcome after pediatric brain injury. *Journal of Communication Disorders*, *33,* 333–344.

Coren, S. (1994). Twinning is associated with an increased risk of left-handedness and inverted writing hand posture. *Early Human Development*, *40,* 23–27.

Coren, S., & Halpern, D. (1991). Left-handedness: A marker for decreased survival fitness. *Psychological Bulletin*, *109,* 90–106.

Dennis, M., & Barnes, M. A. (1994). Neuropsychologic function in same-sex twins discordant for perinatal brain damage. *Journal of Developmental and Behavioral Pediatrics*, *15,* 124–130.

DiScala, C., Lescohier, I., Barthel, M., & Li, G. (1998). Injuries to children with attention deficit hyperactivity disorder. *Pediatrics*, *102,* 1415–1421.

Earls, C. M., Quinsey, V. L., & Castonguay, L. G. (1987). A comparison of three methods of scoring penile circumference changes. *Archives of Sexual Behavior*, *16,* 493–500.

Ellis, A. (1951). A study of 300 sex offenders. *International Journal of Sexology*, *4,* 127–134.

Finger, S., & Almli, C. R. (1984). *Early brain damage: Vol. 2. Neurobiology and behavior.* New York: Academic Press.

Fisch, G. S., Simensen, R., Tarleton, J., Chalifoux, M., Holden, J. J., Carpenter, N., et al. (1996). Longitudinal study of cognitive abilities and adaptive behavior levels in fragile X males: A prospective multicenter analysis. *American Journal of Medical Genetics, 64,* 356–361.

Freund, K. (1967). Diagnosing homo- or heterosexuality and erotic age-preference by means of a psychophysiological test. *Behaviour Research and Therapy*, *5,* 209–228.

Freund, K. (1981). Assessment of pedophilia. In M. Cook & K. Howells (Eds.), *Adult sexual interest in children* (pp. 139–179). London: Academic Press.

Freund, K., & Blanchard, R. (1983). Is the distant relationship of fathers and homosexual sons related to the sons' erotic preference for male partners, or to the sons' atypical gender identity, or to both? *Journal of Homosexuality*, *9,* 7–25.

Freund, K., & Blanchard, R. (1989). Phallometric diagnosis of pedophilia. *Journal of Consulting and Clinical Psychology*, *57,* 100–105.

Freund, K., & Blanchard, R. (1998). Gender identity and erotic preference in males. In C. M. Davis, W. L. Yarber, R. Bauserman, G. Schreer, & S. L. Davis (Eds.), *Handbook of sexuality-related measures* (pp. 454–462). Thousand Oaks, CA: Sage.

Freund, K., Scher, H., & Hucker, S. (1983). The courtship disorders. *Archives of Sexual Behavior*, *12,* 369–379.

Freund, K., & Watson, R. J. (1991). Assessment of the sensitivity and specificity of a phallometric test: An update of phallometric diagnosis of pedophilia. *Psychological Assessment*, *3,* 254–260.

Frosh, J., & Bromberg, W. (1939). The sex offender—A psychiatric study. *American Journal of Orthopsychiatry*, *9,* 761–776.

Frydman, M. (1996). The smoking addiction of pregnant women and the consequences on their offspring's intellectual development. *Journal of Environmental Pathology, Toxicology, and Oncology*, *15,* 169–172.

Gerring, J. P., Brady, K., Chen, A., Vasa, R., Grados, M., Bandeen-Roche, K. J., et al. (1998). Premorbid prevalence of ADHD and development of secondary ADHD after closed head injury. *Journal of the American Academy of Child and Adolescent Psychiatry*, *37,* 647–654.

Gottfried, A. W. (1973). Intellectual consequences of perinatal anoxia. *Psychological Bulletin*, *80,* 231–242.

Hambridge, J. A. (1994). Pedophiles' ratings of adult and child photographs using a semantic differential. *Journal of Forensic Sciences*, *39,* 456–461.

Harris, G. T., Rice, M. E., Quinsey, V. L., Chaplin, T. C., & Earls, C. (1992). Maximizing the discriminant validity of phallometric assessment data. *Psychological Assessment*, *4,* 502–511.

Hayes, A., & Batshaw, M. L. (1993). Down syndrome. *Pediatric Clinics of North America*, *40,* 523–535.

Henn, F. A., Herjanic, M., & Vanderpearl, R. H. (1976). Forensic psychiatry: Profiles of two types of sex offenders. *American Journal of Psychiatry*, *133,* 694–696.

Henry, P. C., Hauber, R. P., & Rice, M. (1992). Factors associated with closed head injury in a pediatric population. *Journal of Neuroscience Nursing*, *24,* 311–316.

Hepper, P. G., Shahidullah, S., & White, R. (1991). Handedness in the human fetus. *Neuropsychologia*, *29,* 1107–1111.

Hucker, S., Langevin, R., Wortzman, G., Dickey, R., Bain, J., Handy, L., et al. (1988). Cerebral damage and dysfunction in sexually aggressive men. *Annals of Sex Research*, *1,* 33–47.

Jernigan, T. L., & Sowell, E. R. (1997). Magnetic resonance imaging studies of developing brain. In M. S. Keshavan & R. M. Murray (Eds.), *Neurodevelopment and adult psychopathology* (pp. 63–70). New York: Cambridge University Press.

Kennard, M. (1938). Reorganization of motor function in the cerebral cortex of monkeys deprived of motor and premotor areas in infancy. *Journal of Neurophysiology*, *1,* 477–496.

Kieler, H., Cnattingius, S., Haglund, B., Palmgren, J., & Axelsson, O. (2001). Sinistrality—a side-effect of prenatal sonography: A comparative study of young men. *Epidemiology*, *12,* 618–623.

Kolb, B., Gibb, R., & Gorny, G. (2000). Cortical plasticity and the development of behavior after early frontal cortical injury. *Developmental Neuropsychology, 18,* 423–444.

Koskiniemi, M., Kyykkä, T., Nybo, T., & Jarho, L. (1995). Long-term outcome after severe brain injury in preschoolers is worse than expected. *Archives of Pediatric and Adolescent Medicine*, *149,* 249–254.

Kozma, C. (1998). On cognitive variability in velocardiofacial syndrome: profound mental retardation and autism. *American Journal of Medical Genetics*, *81,* 269–270.

Kraus, J., & McArthur, D. (1996). Epidemiologic aspects of brain injury. *Neurological Clinics*, *14,* 435–450.

Kuban, M., Barbaree, H. E., & Blanchard, R. (1999). A comparison of volume and circumference phallometry: Response magnitude and method agreement. *Archives of Sexual Behavior*, *28,* 345–359.

Langevin, R. (1985). Introduction. In R. Langevin (Ed.), *Erotic preference, gender identity, and aggression in men: New research studies* (pp. 1–13). Hillsdale, NJ: Erlbaum.

Langevin, R., Hucker, S. J., Handy, L., Purins, J. E., Russon, A. E., & Hook, H. J. (1985). Erotic preference and aggression in pedophilia: A comparison of heterosexual, homosexual, and bisexual types. In

R. Langevin (Ed.), *Erotic preference, gender identity, and aggression in men: New research studies* (pp. 137–159). Hillsdale, NJ: Erlbaum.

Langevin, R., Wortzman, G., Dickey, R., Wright, P., & Handy, L. (1988). Neuropsychological impairment in incest offenders. *Annals of Sex Research*, *1*, 401–415.

Langevin, R., Wortzman, G., Wright, P., & Handy, L. (1989). Studies of brain damage and dysfunction in sex offenders. *Annals of Sex Research*, *2*, 163–179.

Levin, H. S., Fletcher, J. M., Kusnerik, L., Kufera, J. A., Lilly, M. A., Duffy, F. F., et al. (1996). Semantic memory following pediatric head injury: Relationship to age, severity of injury, and MRI. *Cortex*, *32*, 461–478.

Lewis, D. A. (1997). Development of the primate prefrontal cortex. In M. S. Keshavan & R. M. Murray (Eds.), *Neurodevelopment and adult psychopathology* (pp. 12–30). New York: Cambridge University Press.

Lund, J. S. (1997). Development of the cerebral cortex: an overview. In M. S. Keshavan & R. M. Murray (Eds.), *Neurodevelopment and adult psychopathology* (pp. 3–11). New York: Cambridge University Press.

Lund, J. S., & Lewis, D. A. (1993). Local circuit neurons of developing and mature macaque prefrontal cortex: Golgi and immunocytochemical characteristics. *Journal of Comparative Neurology*, *328*, 282–312.

Mahoney, W. J., D'Souza, B. J., Haller, A., Rogers, M. C., Epstein, M. H., & Freeman, J. M. (1983). Long-term outcome of children with severe head trauma and prolonged coma. *Pediatrics*, *71*, 756–762.

Marlow, M., Roberts, B. L., & Cooke, R. W. I. (1989). Laterality and prematurity. *Archives of Disease in Childhood*, *64*, 1713–1716.

Needleman, H. L, Schell, A., Bellinger, D., Leviton, A., & Allred, E. N. (1990). The long-term effects of exposure to low doses of lead in childhood. An 11-year follow-up report. *New England Journal of Medicine*, *322*, 83–88.

Neyens, L. G., Aldenkamp, A. P., & Meinardi, H. M. (1999). Prospective follow-up of intellectual development in children with a recent onset of epilepsy. *Epilepsy Research*, *34*, 85–90.

Olson, H. C., Feldman, J. J., Streissguth, A. P., Sampson, P. D., & Bookstein, F. L. (1998). Neuropsychological deficits in adolescents with fetal alcohol syndrome: Clinical findings. *Alcoholism: Clinical and Experimental Research*, *22*, 1998–2012.

Overgaard, J., Christensen, S., Hvid-Hansen, O., Haase, J., Land, A., Hein, O., et al. (1973). Prognosis after head injury based on early clinical examination. *Lancet*, *2*, 631–635.

Pfefferbaum, A., Mathalon, D. H., Sullivan, E. V., Rawles, J. M., Zipursky, R. B., & Lim, K. O. (1994). A quantitative magnetic resonance imaging study of changes in brain morphology from infancy to late adulthood. *Archives of Neurology*, *51*, 874–887.

Plant, T. M. (1988). Neuroendocrine basis of puberty in the rhesus monkey (*Macaca mulatta*). In L. Martin & W. F. Ganong (Eds.), *Frontiers in neuroendocrinology* (Vol. 10, pp. 215–238). New York: Raven Press.

Quinsey, V. L., Arnold, L. S., & Pruesse, M. G. (1980). MMPI profiles of men referred for a pretrial psychiatric assessment as a function of offense type. *Journal of Clinical Psychology*, *36*, 410–416.

Radcliffe, J., Bunin, G. R., Sutton, L. N., Goldwein, J. W., & Phillips, P. C. (1994). Cognitive deficits in long-term survivors of childhood medulloblastoma and other noncortical tumors: Age-dependent effects of whole brain radiation. *International Journal of Developmental Neuroscience*, *12*, 327–334.

Saigal, S., Rosenbaum, P., Szatmari, P., & Hoult, L. (1992). Non-right handedness among ELBW and term children at eight years in relation to cognitive function and school performance. *Developmental Medicine and Child Neurology*, *34*, 425–433.

Scott, M. L., Cole, J. K., McKay, S. E., Golden, C. J., & Liggett, K. R. (1984). Neuropsychological performance of sexual assaulters and pedophiles. *Journal of Forensic Sciences*, *29*, 1114–1118.

Taylor, H. G., Yeates, K. O., Wade, S. L., Drotar, D., Klein, S. K., & Stancin, T. (1999). Influences of first-year recovery from traumatic brain injury in children. *Neuropsychology*, *13*, 76–89.

Wesseling, J., VanDriel, D., Heymans, H. S., Rosendaal, F. R., Geven-Boere, L. M., Smrkovsky, M., et al. (2001). Coumarins during pregnancy: long-term effects on growth and development of school-age children. *Thrombosis and Haemostasis*, *85*, 609–613.

Williams, C. S., Buss, K. A., & Eskenazi, B. (1992). Infant resuscitation is associated with an increased risk of left-handedness. *American Journal of Epidemiology*, *136*, 277–286.